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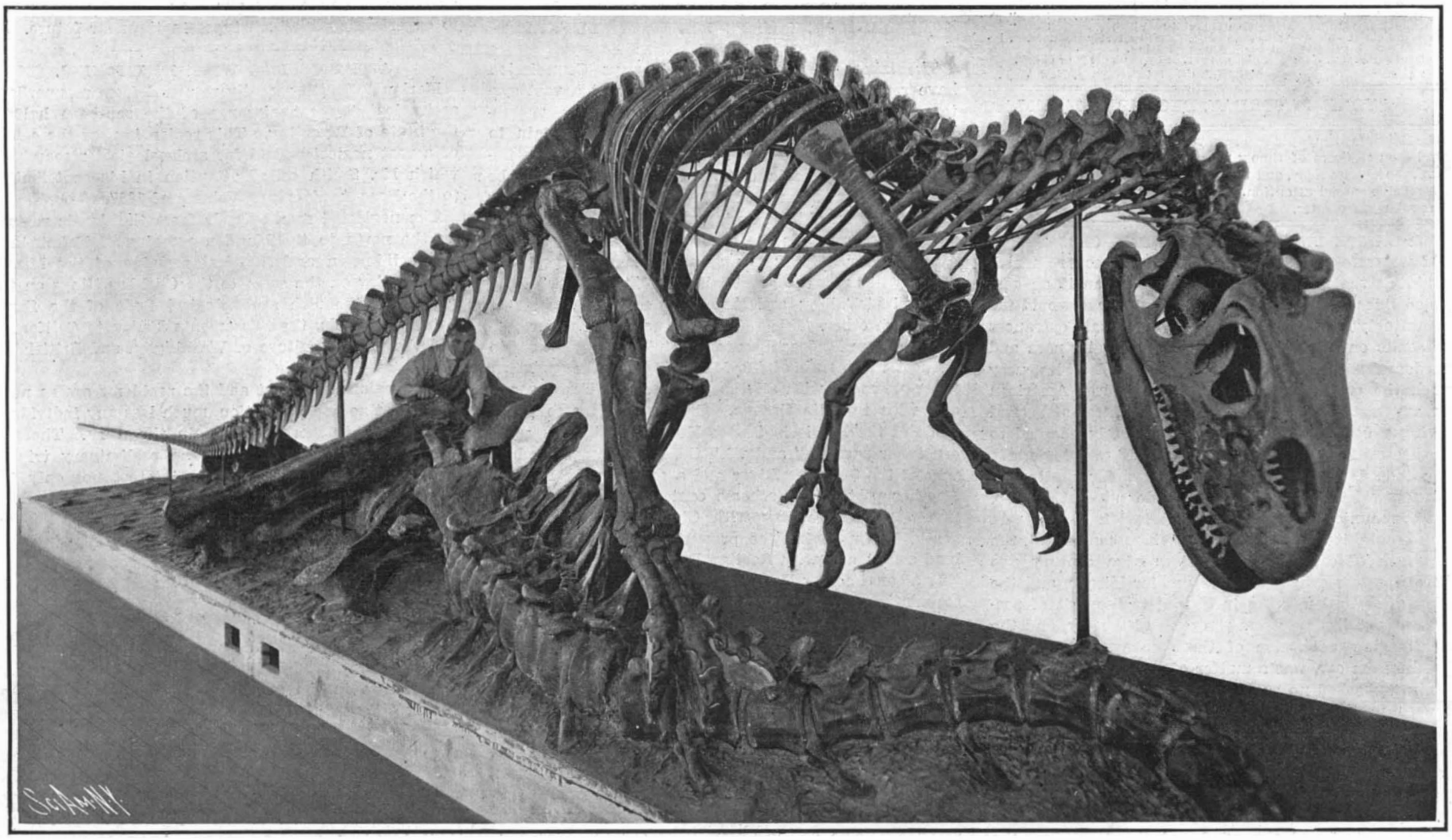
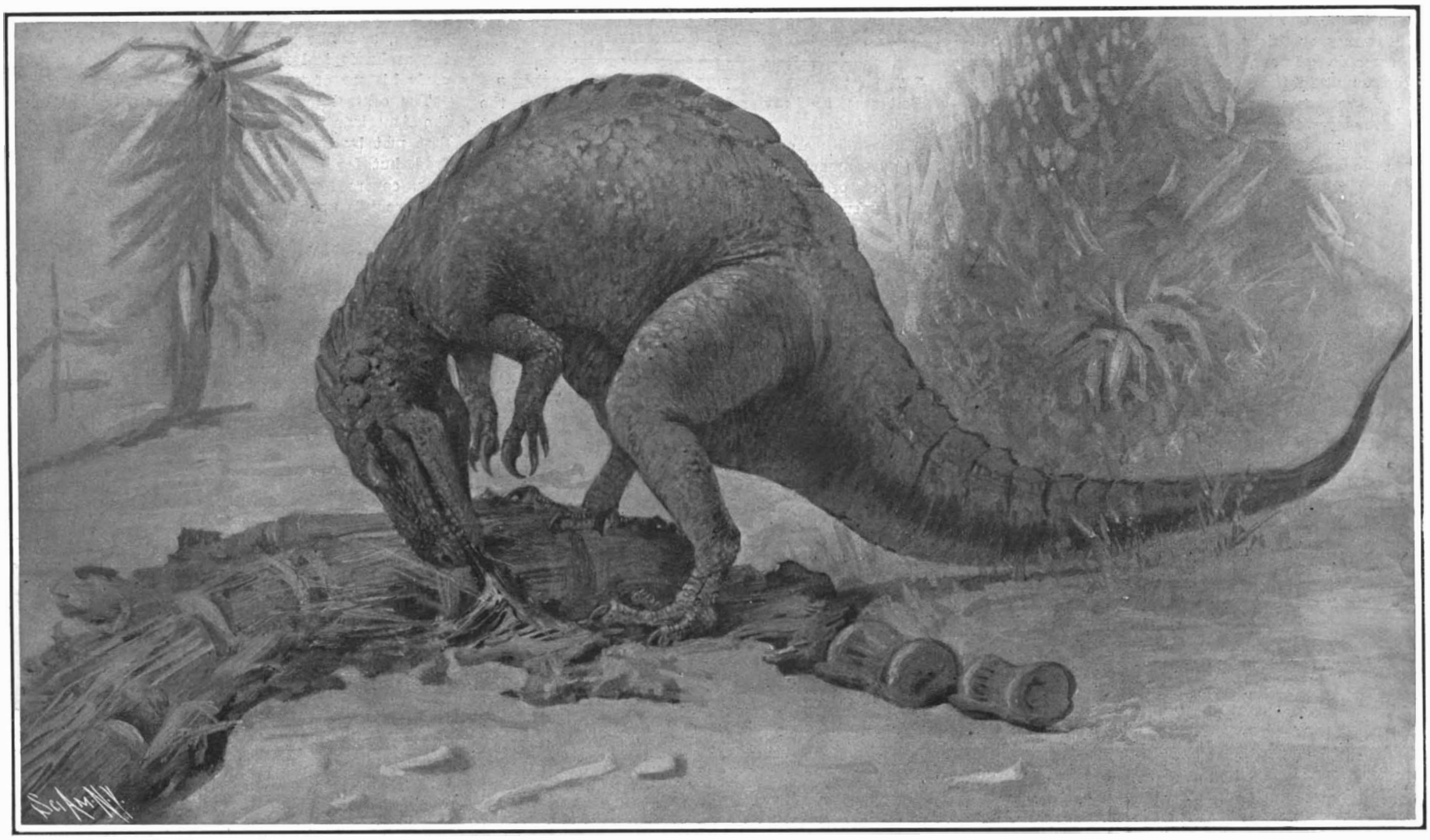


The Mounted Skeleton of the Allosaurus Standing Over the Vertebræ of Its Prey.



From a painting by Charles R. Knight.

Allosaurus was a flesh-eating dinosaur that preyed upon the larger vegetarian dinosaurs. Thus the great unwieldly brontosaurus, seventy feet long, was exterminated by the smaller and more active allosaurus.

Probable Life Appearance of the Allosaurus. The Creature is Here Shown Feeding on the Remains of a Brontosaurus.

A CARNIVOROUS DINOSAUR.—[See page 446.]

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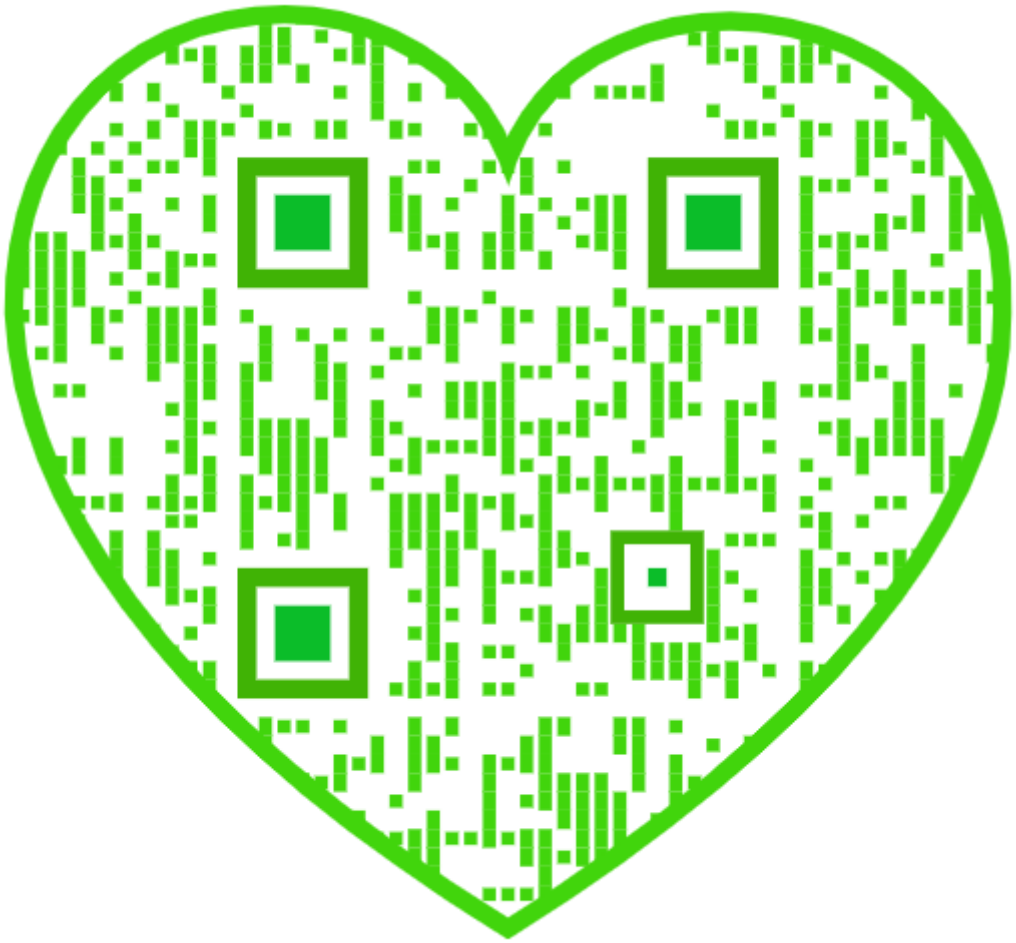

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NEW YORK, SATURDAY, DECEMBER 14, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

SEPARATE ENTRANCES AND EXITS ON CARS.

If we were asked to name the one measure which would do the most to facilitate rapid transit on congested lines of suburban and city travel, we would unhesitatingly suggest the provision of separate entrances and exits on cars. For all our boasted alertness and freedom from tradition we are, even in America, very much the creatures of habit. The typical American car, of great length, provided with a central aisle, and having a door at each end, was admirably adapted to the necessities of the day in which it was invented; and, indeed, even at the present time, for continuous journeys where long runs are made without a stop, and communication throughout the length of the train is desirable, it still remains, all things considered, the best type of car. Three quarters of a century ago there was less congestion and greater leisure, and the delay of several minutes incidental to the exit of passengers, one by one, from the ends of the car, and the equally slow admission of the passengers who were boarding the car, was a matter of small moment. Certainly it worked no such hardship upon the public as it does in these times of strenuous haste. But the phenomenal growth of our cities, the equally remarkable increase in the percentage of people that travel and in the frequency of trips per individual, have rendered the once-useful end-door car about the worst possible type of conveyance for rapid transit.

The spectacle of the whole of the traffic on the splendid subway system of this city being held up, as it is, at Forty-second Street to allow twenty or thirty people to file, one by one, through a narrow door, and then twenty or thirty other people to file in through the same door, is one of the most ridiculous anomalies to be found in the whole field of transportation to-day. Here was a case in which forty millions of the city's money was expended in producing what is, without exception, the very finest system of city rapid transit in the world. It was built of the best materials and equipped throughout with the most up-to-date plant available. No expense was spared in the purchase of costly real estate at street corners, in order to reduce the curves and allow the fastest possible speed to be made by express trains. And yet, when the subway was turned over to the operating company, its engineers deliberately proceeded to throttle down the system to about seventy per cent of its proper maximum capacity, by equipping it with the worst possible form of car that could be used. We smile contemptuously at the ox-car of the Hindoo, the jinricksha of the Japanese, and the passenger wheelbarrow of China; yet the conservatism which maintains these curios in existence is not one whit more hidebound than the perverse stupidity which put the end-door passenger car in our Subway.

However, there is an end to all things, and there may be to this; for we are encouraged to note that the Hudson Companies are making provision, by the use of center doors and separate loading and unloading platforms, for the proper separation of passengers; and the Metropolitan Street Railway Company are about to achieve the same end, by placing on the streets cars with wide end-platforms, each of which has a separate entrance and exit door. It is but fair to the reputation of the last-named company, however, to state that, according to their own admission, they have been impelled to this momentous change by purely financial considerations, the primal object being the gathering in of a large number of nickels which at present are lost to the company. Be that as it may, the operation of the cars will be accelerated, and the many discomforts attending the present single entrance will be avoided.

To the Illinois Central Company and its former sagacious president is due the credit for the introduction into this country of what is unquestionably the best car for the rapid handling of passengers. We refer to what is known as the "side door" car; that is, one in which the seats are arranged transversely, with a door in the side of the car adjoining each seat. The advantages of this system are obvious; for on the arrival of a loaded train at a station the time of unloading is simply that occupied by four or five persons in passing out at one exit, as compared with thirty or forty persons, which must be discharged through each end door of the old type of car. Figures recently elicited from the management of the Illinois Central Railroad in answer to a request from the Merchants' Association of this city, show the time of stops at suburban stations has been reduced in some cases to one-fourth of that occupied when the old cars were in service.

COMPREHENSIVE SCHEME FOR NATIONAL WATERWAYS.

The labors of the Inland Waterways Commission have resulted in the proposal to construct a vast system of improvements, which, because of recent public utterances upon the subject, is pretty certain to receive the indorsement of those interested in the improvement of our inland waterways. An effort will be made to secure from the coming Congress the necessary legislation for making a beginning of the work. The Commission recommends the construction of a network of canals, river improvements, and channel deepening, which will unite the great lakes with the rivers of the Mississippi Valley; and that will connect these rivers with each other. This will secure unbroken water connection from Hudson Bay to the Gulf. It is proposed to connect the mouth of the Mississippi by the "western inner passage" with all the ports on the Texas coast, and with the Rio Grande. Connection is also to be made of the Mississippi with Mobile Bay by the "eastern inner passage," and with the Atlantic seaboard by way of the Suwanee River and a canal across Florida. Another part of the scheme contemplates the connection of Delaware Bay with Chesapeake Bay to the south, by improving the present Delaware and Maryland canal; and with Raritan Bay to the north by cutting a canal across New Jersey. Finally, it is proposed to cut through the Isthmus of Cape Cod, and provide a direct route from Long Island Sound into Massachusetts Bay and Boston harbor.

The plan includes the improvement of the lower and upper Mississippi; of the Red River of the North—this last in conjunction with a canal into Canada and to Hudson Bay; the improvement of the Illinois; of the Ohio to Pittsburg and the Monongahela above Pittsburg; of the Cumberland and Tennessee into Alabama; and of the Arkansas and Red River to Texas. It is not proposed to execute the whole of this vast work at once. Some of the Commission are in favor of a bond issue large enough to furnish funds for starting the work; and they are of the opinion that, although the total cost will be enormous, the scheme must inevitably pay its own way as traffic develops.

THE LOSS OF THE FRENCH AIRSHIP "LA PATRIE."

Believers in heavier-than-air flying machines the world over are at present enjoying a good laugh at the discomfiture of the French over the loss of their first government dirigible "La Patrie," which, despite the efforts of 200 men who were holding it while some repairs were being made to the machinery on November 30 last, was driven aloft by a sudden gust of wind, and went on a voyage to Great Britain on its own account. Only the week before, the airship, which has been maneuvering about Paris successfully all summer, was driven from Paris to Verdun, on the French frontier—a distance of about 147 miles—in seven hours and five minutes (21 miles an hour); and it was intended to use it for the protection of the French frontier. The easy way in which it broke loose from the trained soldiers of the aeronautic corps who had charge of it, was laughable in the extreme. Despite the fact that one of the valves is said to have been opened just before the airship ascended, it does not seem to have come to earth in less than four days. The start was made on Saturday morning, and on Sunday it was reported as being seen passing over the northeast coast of Ireland. The following day it was sighted above Scotland; while on Wednesday, according to cable dispatches, it had drifted back above the Emerald Isle, where it is said to have come to earth, knocked off some of the machinery, and again ascended immediately. This rather improbable story is verified in a way from the fact that the loss of a propeller, when the airship was making a trip on October 26 last, caused it to immediately rise a distance of 1,200 feet, after which, in this instance, the men on board were able to drive the airship, by means of its single propeller, back to its shed. Whether the airship will come to earth or will land in the ocean, is at present a matter of conjecture. As far as is known, at the time of our going to press, it is still floating about with the winds—a derelict of the air.

The demolishment of the British military airship by a storm last October, and the easy loss by the French soldiers of their first national military dirigible, has strongly brought out the fact that any nation which is to have a fleet of dirigible balloons, or airships, must provide suitable sheds to house them at all places where they are likely to stop, and also that they must be well protected when undergoing repairs. The fact that "La Patrie" remained aloft for four days speaks well for the tightness of its envelope. Had there been anyone on board the airship, it could, of course, have been brought to earth at once. With an aeroplane or other heavier-than-air machine such a mishap could not occur; for although the machine might possibly start and soar aloft, as soon as the power gave out it would come to earth. The loss of "La Patrie," therefore, has brought out another distinct advantage of the flying machine over the dirigible balloon. It is gratifying to note that our War Department expects to experiment with both types in the near future.

ARCHÆOLOGICAL WORK IN WYOMING.

Harlan I. Smith recently returned from a superficial archæological reconnaissance of the southern half of the State of Wyoming. This region is near the center of a vast neglected field for archæological research, to which Mr. Smith called attention in his contribution to the Boas Anniversary Volume of 1907.

The neglected area extends from the Arctic regions on the north to the Mandan remains of Dakota and the well-known archæological remains of the Mississippi Valley on the east; to the Cliff Dwellings on the south and the rich archæological finds of the Santa Catalina Islands, the Sacramento Valley to California, and the plateau culture of Washington and British Columbia on the west.

The region is so vast and the problems are so numerous that no one institution, much less any individual, might hope to more than begin the work. The museum has done this through the preliminary trip of Mr. Smith. He endeavored to interest not only the local educational institution, but all the great museums in the country to co-operate in the work.

Among the problems to be solved, the following may be mentioned: When did man first appear in the region? Judging from the results of exploration in other places, it may take many years of the combined efforts of all who are interested before extensive evidence on this point is discovered. What was the culture of these first inhabitants? Was there more than one culture in the area, either at various places or during different periods? How was the culture affected by the introduction of the horse? No doubt the coming of the horse to a people whose only beast of burden was the dog caused a great advance in their general culture, as it would enable them to travel farther in search of food, to possess and transport more property, and to become somewhat more independent of the scanty water supply.

The larger part of the area was inhabited by tribes of Indians belonging to the Athabascan, Algonquin, Siouan, and Shoshonean groups. An examination of the archæological remains will throw light upon the early history of these people and their migrations.

The central portion of the area was the home of the American bison, upon whom the Indians, when first met by the whites, depended for not only their food, but for the material for their clothing, moccasins, covers for their tipis and ferryboats or rafts, backgrounds upon which to paint their calendars, and other things of like character. The horns and bones furnished them with material for various articles and implements, among which may be mentioned spoons, bowls, skin scrapers, etc.

After all the vaunted superiority of the white race, our people to-day are holding the cattle much as the Indians held the buffalo. For instance, the Indians held the herds at the North Platte River in order that the tribes living north of the river might be able to get buffalo all through the year, for if left to themselves, the herd would have traveled farther to the south in winter. Our round-up and general treatment of the cattle of the plains resembles to-day and always has in wildness and cruelty the buffalo hunt of the red men.

In the eastern part of Wyoming, some extensive quarries, where the prehistoric people found quartzite and jasper, out of which to make chipped implements, have been known for some years. Mr. Smith visited these, securing specimens and photographs, and also discovered other extensive quarries, some of them covering acres in the same general region. Besides these, notes were taken of still other quarries known to the local ranchers. Nearly everywhere in Wyoming, but more in the eastern part, circles of stones marking the sites of ancient tipis were found. They may be counted by the hundred in the southern part of Converse County. These stones were no doubt used to hold down the skin covering of the tipi. Stones are still employed for this purpose by the Blackfeet Indians in Montana, only a short distance to the north.

Pictographs painted in red and black and petroglyphs cut or pecked on the cliffs are noted, especially in the vicinity of the Wind River Mountains. A number of these were photographed. Some of them

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represent horses, proving them to have been made since the white man brought horses to America; others represent the buffalo.

Steatite pots in the form of an egg, with the tip of the larger end cut off, and apparently of a type unknown in other parts of America, were noticed, especially in western Wyoming. True pottery was rare. Less than a dozen sites were found to have been located where it occurred, and these were all well toward the southern part of the State. They probably mark the northern limits of pottery in this portion of the area.

In the vicinity of Hammond in the Algonquin area, caves into which the wolves had dragged bones of cattle, sheep, and other animals, and in front of which are much village debris and a large number of tipi circles as well as some petroglyphs, probably contain many remains, and this vicinity, as well as the eastern slope of the Wind River Mountains, would probably repay detailed exploration. Several months' work in the latter region would be sure to enable the explorer to secure a collection of photographs illustrating the art of the vicinity, as executed in the form of petroglyphs.

It would seem to be the duty of the students of the Cliff Dwelling and Pueblo region to explore northward into this vast neglected area, in an attempt at finding the northern limit of that culture. The students of the archæology of the Mississippi Valley have a similar duty to perform in determining the western limits of the archæological culture of that valley. While the students of California owe it to the world to investigate the eastern portion of California and Nevada, the eastern limits of the plateau culture of southern British Columbia and Washington should also be defined.

THE MYSTERIOUS RAILWAY DISASTERS IN ENGLAND.

If Sherlock Holmes were a character in real life instead of a novelist's puppet, he would find just now a more profitable field for his talents in the investigation of accidents than in that of crimes. The mind of the British public has been made seriously uneasy by a succession of railway disasters for which no adequate explanation has hitherto been forthcoming. The last of the series was the derailment at Shrewsbury on October 15 of a London & North-Western express from Crewe to South Wales, with the result of several deaths and a large number of injuries. What makes this accident especially alarming is its close likeness to the two most serious disasters of 1906—the derailment of an American boat express at Salisbury on July 1 and that of a Great Northern express at Grantham on September 20.

The points of similarity are as follows: In each case the accident occurred at night to a fast express train when traveling, at a higher speed than normally permitted, around a curve close to an important station where switches and signals are abundant. In each case, also, the engine driver was a steady and experienced man, and both he and his fireman were instantly killed, so that it has been impossible to gain any first-hand testimony as to why the signals and the speed regulations were ignored. At Salisbury and Shrewsbury the derailment occurred on the curve itself, but at Grantham on a straight piece of line immediately following it. The Shrewsbury driver was running at sixty miles an hour over a portion of the track where ten miles was the official rule and twenty the highest speed consistent with safety.

This apparent neglect of definite orders has naturally directed much attention to the "human factor." May it not have happened, people are asking, that the driver was seized with some sudden illness which rendered him incapable? This theory has been generally pooh-poohed by railway men themselves. At the Board of Trade injuiry at Shrewsbury both a locomotive foreman and a locomotive superintendent declared emphatically that they had never known an instance of a driver collapsing while on the footplate. It so happened, however, that only a few days after this evidence was given, a Midland driver actually died on his engine, though apparently in good health at the beginning of his journey, and two or three other instances of paralysis, etc., under similar conditions have since been published. After the Shrewsbury accident Mr. Lloyd George, the president of the Board of Trade, took the unusual course of ordering an autopsy to be performed on the body of the driver, and the surgeon's report showed that in this case, at any rate, there was no physical failure.

Another suggestion is that the engine driver, while far short of an entire collapse, may have had his wits temporarily dulled by an insidious drowsiness. The editor of the automobile column in the London Times lays great stress on this possibility. At least one serious automobile accident, he says, has been due to the chauffeur's falling asleep. He has himself over and over again, when rushing rapidly through the air, felt not so much a desire to sleep as a physical inability to remain awake. It came over him with an irresistible force, which he could not stop by changes of position, or violent shakings of the head, or even pain deliberately self-inflicted. Other motorists, he declares, have confessed to him a similar experience. Quite independently, a railway man of many years' standing offers a similar explanation in the Pall Mall Gazette. When working as a fireman on a fast train, he has many a time looked up and seen the driver standing as it were in a dream, quite oblivious of any signals. On hearing the fireman's voice of warning, the driver at once came to himself and everything was all right. In the judgment of this correspondent, it is significant that in these recent disasters the driver, an elderly man, had as his companion on the engine a man who was not his ordinary mate. Now a strange, and especially a young, fireman is not in touch with his driver. He is likely to be attending more closely to his own particular duties, and if his driver goes "wool gathering," he has no opportunity of noticing it. At the same time, the staying power of the average driver is decreased by reason of his having to take longer journeys than formerly. One may add that the risk of such a lapse is all the greater when the journey is at night, and when, as at Shrewsbury, a heavy rainstorm causes the signals to stand out less clearly than usual.

It must also be recognized, in connection with the "human factor," that a driver has often a strong temptation—too strong a temptation, some say—to run at excessive speed in order to make up for lost time. The Shrewsbury train, however, was so nearly on time that this explanation scarcely fits the present instance.

We now turn to the theories which explain these disasters as due to some mechanical defect. It was the unanimous opinion of the jury at the coroner's inquest upon the victims of the Shrewsbury accident that the brake power of the train was insufficient. There can be no doubt, according to the evidence, that the brake was actually applied. The guard testified that at Crewe Bank, where the danger signal was passed, he found the train traveling too fast. He went to the hand brake, and found the vacuum brake already full on, but with little diminution of speed. A Board of Trade inspector who examined the wrecked engine found that the brake had been fully applied, with no appearance that it had been in any way inoperative. Railway officials, in commenting upon the catastrophe, will not admit for a moment that the brakes can have been out of order, and declare that their experience gives no confirmation to the possibility of any such cause. A very different position, however, has been taken by several drivers who have communicated their views to the press. They affirm that they have known many instances in which serious disasters from brake failure were averted by a very narrow margin. "Some years ago," says one of them, as reported in the Manchester Guardian, "I slightly overran the place that I should have stopped at, owing to this cause. When the official came to investigate it, I told him the brake did not go on when applied. He said, 'You must not say that; if you do, you will be discharged.'" It is stated by other drivers that instances of the delay or failure of brakes to act are never reported because "the bosses will never admit the brakes are wrong—it's always the driver." And a passenger in a signed letter to the London Tribune relates the following experience: "About two years ago, while I was waiting for a train at Harrogate station, an express train came in on its way to King's Cross. When the time came for the train to resume its journey it did not move, and in answer to the superintendent the driver said the automatic vacuum brake would not act. After twenty minutes' delay the train started on its journey. Is not the conclusion inevitable that these brakes get out of order more frequently than we read of?"

It may perhaps be as well to mention here, for what it is worth, a theory that the heavy downpour of rain kept the metals covered with a film of water upon which the locked wheels glided so that the train ran away. It has also been suggested that, while there was no fault with the brakes, the driver found it impossible to shut off steam; that the valve spindle, under the high working pressure, had expanded or even broken. The brakes alone could not stop a train traveling at sixty miles an hour under steam. Realizing his helplessness, the driver then resorted to the only method left of checking his train, namely, reversing his gear, which, according to the evidence, was done just before the crash.

In the course of the correspondence on this subject, publicity has been given by the Yorkshire Observer to a theory of Mr. T. H. Brigg, formerly of Bradford, England, but now of New York. His opinion, in brief, is that accidents of this kind are largely due to the modern type of railway car with its double bogie, as compared with the old-fashioned car, with four or six wheels and a rigid wheel base. Although the bogies give flexibility to a train in rounding a curve, the long bodies of the cars remain rigid, and the buffers on the inside of the curve are all tightly compressed, while those on the outside may possibly not even touch one another. When the driver opens the vacuum brake, the wheels of the engine and tender are powerfully retarded, but the rear cars crowd forward for a time. If the train is on a curve, the inner buffers only are compressed, and the sixty-foot frame of the car becomes an enormously long and powerful lever, operating upon the inner buffer of the car in front to force that car off the track toward the outside of the curve, the fulcrum of the lever being the pivot on which the front bogie turns. Some confirmation is given to this theory in the Shrewsbury case if the brake, as previously suggested, although put on a mile or two back, did not begin to act until the train was actually on the curve. Mr. Brigg's theory, it should be added, is quoted as applicable to the accident which occurred not long ago on an elevated track in the Bronx.

Another mechanical explanation has been offered by Mr. James Keith, a London engineer. He believes that no derailment would have occurred in any of these cases if the wheels had had "the proper depth of guide flanges so called, instead of the little half-beads which usually keep the wheels on the track at moderate speeds." He maintains that the only thing which keeps fast trains from derailment on curves under these conditions is the great weight of modern locomotives and cars bearing on these wheels. This weight, "though a safety at high speed when every point is carefully attended to, becomes a real danger when the train has the slightest inducement to leave the track, as, for instance, on the too sudden putting on or taking off the brakes, or the failure of the brakes to act, or the sudden reversing of the engine, or with one of or all these together and the metals, say, 'greasy,' and because of the extreme oscillation of the present-day huge locomotives and coaches." No change, he points out, has been made in the guard margin of the wheels during the last fifty or sixty years, though the speeds of all trains are on an average at least twice what they were when the said wheels were originally designed.

With so many theories to account for these disasters, it is not surprising that numerous suggestions have been offered for their prevention in future. Among the principal reforms recommended are the more frequent medical inspection of engine drivers; the limitation of the journey to shorter runs; the provision of an extra man on the locomotive or of some better means of communication between the engine and the guard's van; the repetition of signals in the cab of the locomotive by a mechanical contrivance; the use of detonators as warnings at dangerous places at night; and the straightening of curves. The last-mentioned suggestion has been strongly supported by Mr. Andrew Carnegie, writing as an ex-railway superintendent to the London Times. No regulations, he says, can insure safety on such sharp curves, which therefore should not be allowed to exist.

SCIENCE NOTES.

The New York Forest, Fish, and Game Association has published a report dealing with the work of its fish hatcheries. During the past year more than 100,000,000 marine fry have been placed in the sea, and in addition great numbers of trout and other game fishes have been hatched and placed in suitable streams. The association states that year by year it becomes increasingly difficult to obtain a proper supply of water, so widely are both streams and shore waters polluted.

Karatagh occupies a small inclosed basin shut in by high hills. On one side of it rises the Karatagh Mountain, while on the other side flows a river. The recent earthquake, the exaggerated reports of which stated that 200 people were killed, broke away a great section of the mountain, causing it to slide down upon the town. The force of the shocks was already toppling houses when the landslide added to the destruction. Many of the inhabitants were killed in the narrow streets by the falling dwellings, no building in the town being left standing.

M. Georges Urbain, a young assistant professor of the Paris University, claims to have discovered a new metal by separating the element ytterbium into two parts. For some time he has been carrying on experiments in the class of rare earths, and more recently undertook a fractional treatment of ytterbium. This led him to separate a hitherto undiscovered element from the latter, which was supposed to be a simple body up to the present. To the new element he gives the name of *lotherium*, from the county of Lorraine. As to the details of the operations which led him to this important result, he declines to make any information public before presenting a complete memoir upon the subject before the Académie des Sciences. The present experiments were carried out in one of the laboratories of the Sorbonne, to which M. Urbain is attached. He states, however, that he has already made a number of researches regarding the new element, observing its different characteristics by chemical tests and also by spectrum analysis, and comes to the conclusion that it possesses some new properties which will make it of great interest from a scientific standpoint.

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NEW EXPERIMENTS IN RADIO-ACTIVITY.

BY JACQUES BOYER.

The apparatus herewith illustrated have been designed for the purpose of demonstrating the principal properties of radium salts and other radio-active bodies, and exhibiting their luminous, phosphorescent, electric, and thermal effects. Most of the experiments were designed or modified by M. Daune, Mme. Curie's assistant at the Sorbonne, for the exhibition of radio-active phenomena to a class.

The electrical conductivity of the air which is induced by the presence of radium is illustrated by means of the apparatus shown in Fig. 1. Adjustable spark gaps with micrometer scales are connected to the poles of a Ruhmkorff coil. A Geissler tube is connected in series with one pole and its spark gap, and the resistances are so adjusted that sparks pass in the other spark gap only. If a glass tube containing a grain or two of radium is brought near the inactive spark gap the resistance of the air is diminished so that sparks pass and the Geissler tube glows brightly.

The apparatus for the study of the radio-activity of mineral waters (Fig. 2) is composed of an electroscope surmounted by a glass cylinder which contains a central electrode connected with the rod of the electroscope. The gas dissolved in the mineral water is expelled by a current of air which is forced through the container by compressing a rubber bulb. The gas traverses drying tubes containing sulphuric acid and phosphoric anhydride, and then enters the tube that surmounts the electroscope. If the gas possesses radio-active properties due to the presence of radium emanation the electroscope will be discharged. In this manner radio-activity has been detected in the waters of Spa.

M. Daune has devised for these experiments a simple electroscope which is very sensitive to radio-active influences. The gold leaves are suspended from a glass rod which terminates above in a knot and is inclosed in a glass tube, to which it is attached by a metal frame. The radio-active effect on the conductivity of air is manifested at distances of several yards from the radio-active substance, and through paper, wood, metals, the human body, and other objects. A screen of lead 4 inches in thickness diminishes the effect very slightly.

I have seen in the laboratory of the De Lisle establishment at Nogent a remarkable apparatus for the demonstration of the evolution of heat by radium. This apparatus (Fig. 3) consists of a very sensitive thermometer, the bulb of which is hollow and surrounds a thin-walled glass tube which is prolonged beyond the bulb opposite the stem. The thermometer is inclosed in a wide glass tube which is exhausted of air to a "Crookes vacuum" and is sealed around, but not over, the end of the little tube that penetrates the thermometer bulb. If a bit of radium is introduced into this little tube and pushed up into the bulb, the heat evolved by the radium will cause the mercury to expand. The vacuum between the thermometer and the outer tube almost prevents loss of heat by direct thermal radiation from the thermometer itself, but a certain quantity of heat is conducted from the thermometer by the walls of the outer vessel, and thence radiated or conducted away. The rate of this loss of heat increases with the elevation of temperature and when it becomes equal to the constant flow of heat received from the radium the end of the column of mercury ceases to advance. One decigramme (1.4 grains) of radium produces a movement of about four inches, and if the instrument is standardized it may be used as a calorimeter for the measurement of the heat evolved by radium. The most curious of M.

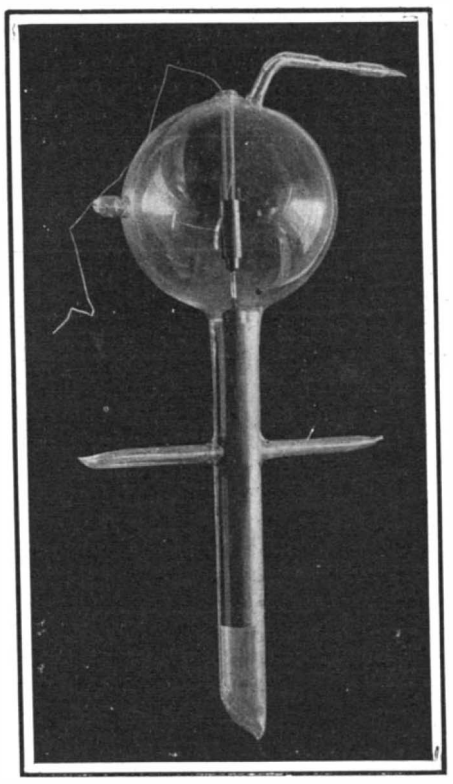

Fig. 4.—"Perpetual Motion" Due to Radio-activity.

Daune's devices is a novel "perpetual motion." The apparatus (Fig. 4) consists of a glass tube containing a small axial glass tube closed at the bottom and open to the outer air at the top, which is fused to the wall of the globe. The lower part of the tube is surrounded by a tube of brass which rests on an insulating post of quartz supported by a brass rod below. The brass tube bears a gold leaf which forms an electroscope.

If a Crookes vacuum is produced in the globe and a little tube containing radium is dropped into the open mouth of the central tube, the negative rays, or β particles, emitted by the radium, traverse the two thin glass tubes and communicate their charge to the enveloping brass tube. The gold leaf diverges until it touches a platinum wire connected to earth, which discharges it and the brass tube to which it is attached. But a new negative charge at once begins to accumulate and when it has attained a certain value the gold leaf again touches the platinum wire and a second discharge takes place. These alternate charges and discharges and to-and-fro movements of the gold leaf are repeated indefinitely under the influence of a very small quantity of radium.

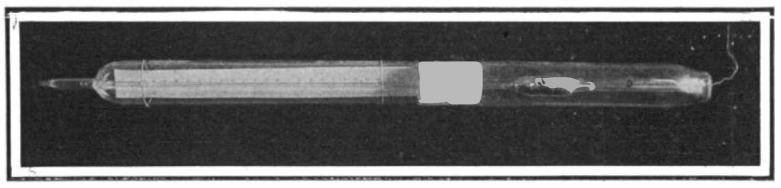

Fig. 3.—Apparatus Showing Evolution of Heat by Radium.

Ramsay's Work on the Degradation of Copper to Lithium.

In a recent lecture delivered at Johns Hopkins University, Prof. Ira Remsen remarked that it is an easy matter to explain the work of Sir William Ramsay to any one who is familiar with chemistry. It is correspondingly difficult to make it clear to those who are not familiar with chemistry. In a few words, Ramsay has made it appear probable that when radium emanation is allowed to stand in contact with a water solution of copper sulphate, a very minute quantity of lithium is formed. He believes that this lithium is formed from the copper. If this be true it is evident that the elementary form of matter known as copper, which has hitherto been regarded as unchangeable, is capable of change. It should be emphasized that the extent of this change is very slight indeed, the quantity of lithium formed being too small an amount to be weighed.

Sir William Ramsay is one of the most skillful experimenters in chemistry to-day, and whatever he says is worthy of the most careful consideration. He believes that this transformation has been effected. In a letter dated September 16, received by Prof. Remsen from Sir William Ramsay, in which he tells of his work, there is nothing to indicate that his belief has been shaken. At the same time, in his published article he is cautious and uses the following words: "These experiments must be considered as preliminary. It is necessary first to find out where to search for the unknown before proper experiments can be made." He further says: "It is evident that the research of which the foregoing is a description, is merely a preliminary survey of the field to be explored, and that much work must be done before the tentative hypothesis which has been put forward can be substantiated."

To the chemist and physicist, Ramsay's results are of special interest because they promise to throw light upon that great problem—the constitution of matter. Those who are looking for practical results, using this expression in the ordinary sense, will be disappointed. There would be little advantage to the world even if copper could be transformed into lithium on a large scale, for as has been stated, the change is extremely small, and there is little or no probability that the extent will be markedly increased. There is nothing whatever in Ramsay's results to suggest the possibility of making copper from lithium, and even if this were possible, its manufacture on a commercial basis would be entirely out of the question, for copper is very much cheaper than lithium.

Sir William Ramsay is continuing his experiments, and in the course of time we may expect to learn from him whether his present views receive confirmation. If this should prove to be the case, physicists and chemists will have food for much thought. One of the fundamental problems presented to scientific men is the nature of the elementary forms of matter and their relations to one another. Anything that throws light on this problem is of importance.

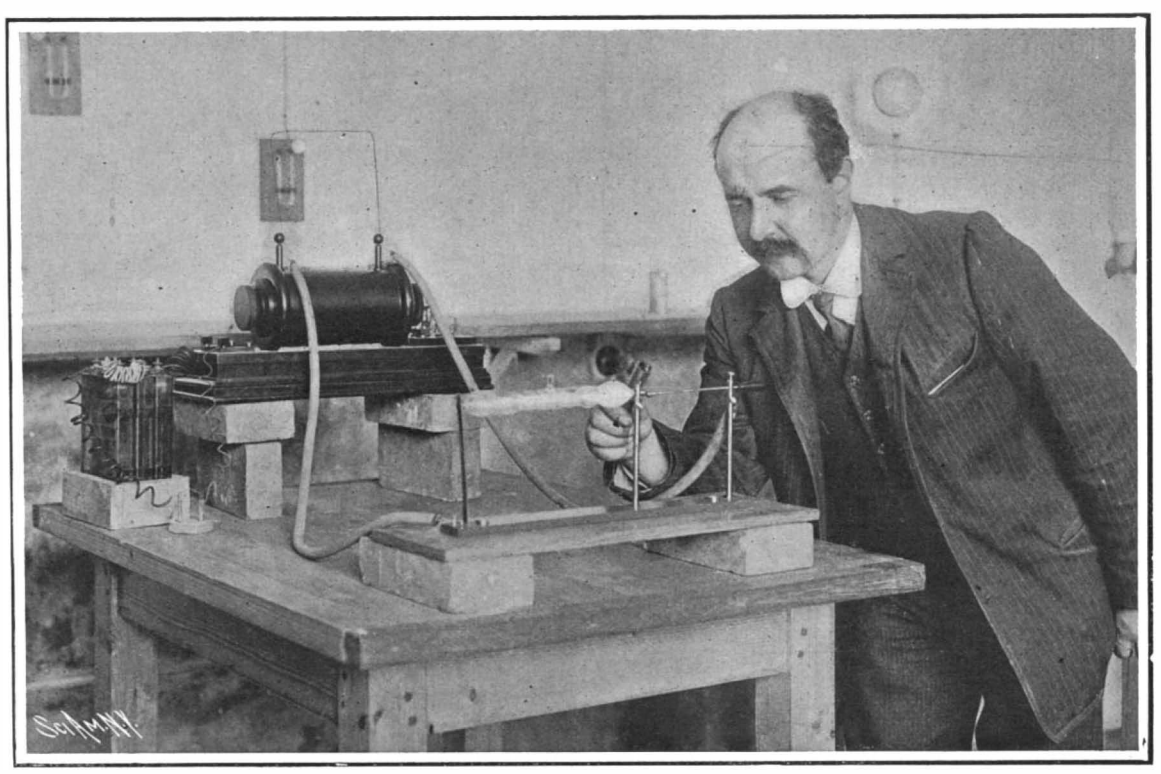

Fig. 1.—Demonstrating the Conductivity of Air Under the Influence of Radium.

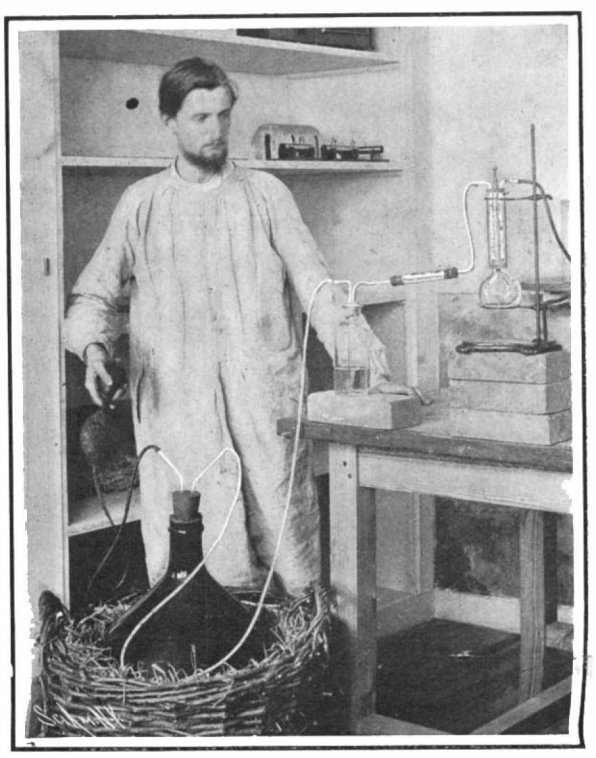

Fig. 2.—Testing Mineral Water for the Presence of Radium Emanation.

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SATURN'S TORES.

BY PERCIVAL LOWELL, LOWELL OBSERVATORY, FLAGSTAFF, ARIZONA.

So much misconception exists in regard to the new discoveries about Saturn, that it may prove useful as well as interesting to the readers of the SCIENTIFIC AMERICAN to have the facts at first hand. For, to begin with, there is a lack of knowledge of what has just been seen, strikingly exemplified by the portrait of Saturn given in the SCIENTIFIC AMERICAN of November 23, which is not only not "a portraiture of the planet as it now appears," lacking indeed every one of the present features, but bears a strangely familiar resemblance to Saturnian pictures of thirty years ago.

In the next place, there seems to be a sad ignorance of celestial mechanics prevalent on the subject, both professional and profane. Perhaps as a mathematician I may be allowed to explain the matter, as I think its general points can be made comprehensible to even a non-mathematical reader. For not only is it perfectly certain that the rings are in process of falling in upon the planet, but this is an inevitable consequence of the mechanical principles involved.

There is an ingrained conservatism in most people to prolong the present; an inertia of mind akin to the inertia of matter, of which it is indeed but a form. The stability of Saturn's rings is an interesting instance in point. Astronomers of the eighteenth century had no misgivings on the subject. Not until Laplace took up the question was there any doubt that Saturn had been eternally aureoled, and solidly at that. Since then, the idea has known one long chronicle of crumbling down. First, Laplace showed that if the rings were of the breadth they seem to be they could not endure, as the tremendous strains to which different parts of them would be subjected by the attraction of Saturn must end in disruption. He accordingly supposed them subdivided into a series of very narrow ones, which would greatly diminish the stress. Peirce then showed that Laplace's supposition was not enough; that for stability the rings must be fluid. Lastly, Clerk-Maxwell took up the subject, and proved that even fluidity was fatal; the rings to be stable must be composed of separate particles, "brickbats," he called them. But some time before this, in 1848, Edward Roche had pointed out that the rings must be composed of discrete particles, because they lay within the limit discovered by him at which a satellite could revolve without disruption from tidal action by the planet. It is amusing now to see discreteness without discretion taken as a last word on the subject, in view of the fact, if my memory serves me rightly, that Clerk-Maxwell himself pointed out that the particles must, in time, some fall in upon the planet, some be driven off to form a satellite. The proof of this is as neat as it is cogent, and not beyond every-day comprehension.

A swarm of particles—particles like our meteorites, these probably are—traveling round a planet is in stable motion *only in the absence of collisions*. For the moment one of the neighbors collides with another, unless both be perfectly elastic—a condition not fulfilled with any substance—a part of the energy of motion is converted by the impact into heat, and thus lost to the system. Now, the energy of motion, or *vis viva*, as it is called, is expressed by $\frac{1}{2}\ mv$, where m is the mass of the body and v its velocity.

The effect of the collision is thus to slow down one of the bodies without adequate compensation to the other, to shorten its orbit in consequence, and so bring it nearer the planet than it was before. The next collision helps on the work, and so it continues until at last some particles fall upon the surface itself, while others pushed outward collect beyond Roche's limit into a new satellite. So much for the inevitable effect of collision.

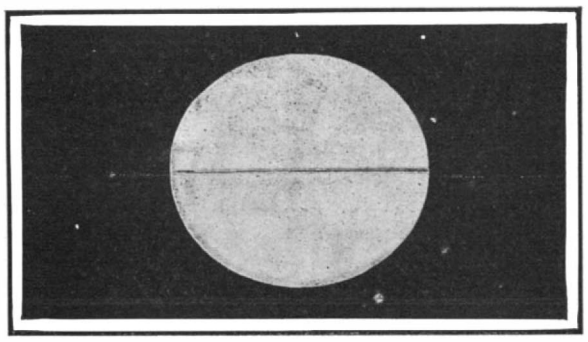
But collisions are certain to occur in a swarm of the sort, unless the particles are so far apart that no possible perturbation from one another or from outside bodies can cause them to touch. Now, the brightness of the chief rings of Saturn shows that the particles are not at great distances apart, on the contrary are relatively crowded. So that even from their mutual pulls upon one another, still more from the action of the satellite, collisions must be common, and thus the stability of the system is certain to be wrecked. But there is nothing catastrophic about it. The system was doomed to die from the moment of its birth, has been breaking up in fact from the instant it began to be. That it will outlast our grandchildren is a safe prophecy, but that it is in process of dissolution is as assured as the law of gravitation itself.

The interest of the new observations consists in no such simple spectacle as a catastrophe, but in a much more subtle and satisfying thing—in the proof they afford, not only of the fact but of the manner of the disintegration of the rings. For they turn out to give evidence of a very pretty case of celestial mechanics, which, though too abstruse to be popularly appreciated, can nevertheless be so put as to be generally understandable.

The ring system of Saturn is composed, beginning from the outside, of ring A, about 10,000 miles in breadth, which extends to Cassini's wide division and is itself divided about half way by Encke's narrow one; from Cassini's division stretches toward the planet, ring B, 16,000 miles, to where the crepe ring, known as ring C, begins, which in its turn continues in, according to the latest previous measures, up to 7,400 miles from the planet's surface. I say previous because the measures just made at Flagstaff show that it extends nearly 4,000 miles farther in.

Now then, for the facts of recent observation.

The first new and interesting circumstance connected with the present appearance of the Saturnian system was the detection at Flagstaff on June 19, 1907, by the writer of a very fine black line threading



THE RINGS OF SATURN VIEWED EDGEWISE.

the central part of the much less dark shade that banded the (approximate) equator of the planet. The detection of the phenomenon speaks for the definition at Flagstaff, thus supporting the space penetration there shown for stars; for at the Yerkes Observatory, Prof. Barnard had not caught it, as he told the writer a few days ago, and it has not been reported from the Lick, though it was visible to all the observers at Flagstaff who examined the planet critically. (The photograph presented above of a drawing made on November 13 shows this detail of the band.

This core to the shadow of the rings is the first point of interest about the new appearances, and proves in a sense anticipatory as well as corroborative, as the reader will presently see, of the explanation about to be given of the much more easily seen phenomena in the rings themselves.

To begin with, it is at once evident that the dark medial line is the shadow of such part of the ring as is plane. Its observed width, 0.10 sec., makes it probable that it is the shadow of the ring A only which is here concerned, and that that ring is therefore practically plane. The dusky band on both sides of it one might at first suppose its penumbra, but calculation shows that it cannot be such, because that penumbra would be only 0.05 sec. wide, whereas the measured breadth of the band is 0.46 sec. Nor can it be due to the shadow of the whole ring system regarded

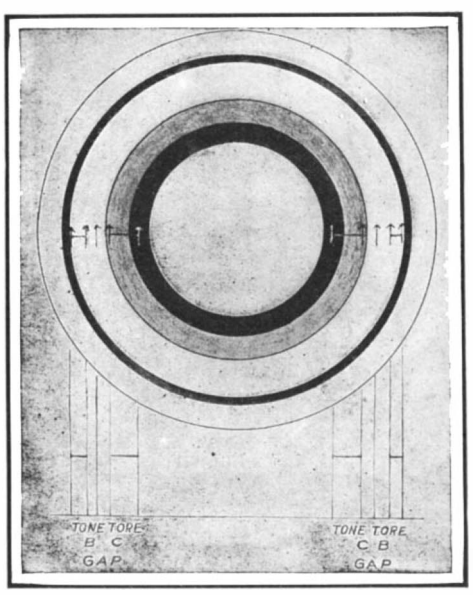


DIAGRAM ILLUSTRATING DR. LOWELL'S THEORY OF SATURN'S RINGS.

as a plane, for that would only measure 0.26 sec. across. Thus the observed shadow is too wide to be accounted for, unless *parts of the rings are out of the general plane of the system*. In that case, however, the phenomenon is just what we ought to see. The dusky fringe on both sides of the dark core becomes explicable when we so consider it, and only then. The shadow as seen at Flagstaff thus tells us that certain parts of the ring system are not flat, but of the nature of tores, a tore being a sort of flattened anchor ring. Tores then are certain portions of the rings, symmetrical all round the planet.

Passing now from the shadow to the appearance presented by the rings themselves, the reader must realize that they are now viewed almost edgewise to the earth, for the elevation of the earth above the plane of the rings was only 40 min. N. on November 3 and 50 min. N. on November 13. For the most part, the rings showed only as the finest of lines of light stretched on either side the disk like golden threads, but in two places upon them brilliant star-like beads stood strung, symmetrically placed on either side the disk and of easy perception. (All six observers saw them instantly.) Detection of agglomerations of the sort is not new. Herschel, Wray, Struve, Bond, etc., perceived such long ago, and the present ones were seen some months since by Barnard at Yerkes, and later by the Lick before they were looked for at Flagstaff, as the planet was not then an object of special study. But the careful measures made at the latter of their position, when reasoned on, prove to negative the old explanations and to lead to a new one of some curiosity. Figures here become necessary.

In radii of Saturn the agglomerations lay at 1.10—1.46, the inner, 1.72—1.92, the outer, from the center of the planet, while a conspicuous gap occurred at 1.58. The inner tore is thus much broader than the outer one.

Now Olbers's explanation, adopted by Seeliger and recently advanced again as if it accounted for the present phenomena, consists in attributing the agglomerations to the piercing by the line of sight across the widest presented breadth of the several rings' supposed plane. It puts the maxima at 1.60 and 2.00, or exactly where the minima now fall, and the observational maxima where the theoretical minima lie. This explanation therefore fails. We must, then, have recourse to another, and the only one which presents itself to answer satisfactorily the requirements is this: That at the points of agglomeration the eye is looking *through particles outside the ring plane* at the points where these swing into greatest perspective at their ansæ.

So much for the evidence afforded that certain portions of the rings are not flat, first by their shadows and second by themselves. But when we consider the character of the witnesses, we perceive that each tells its story from a different standpoint, since in the one case we are looking athwart the rings transversely, in the other longitudinally, and in consequence the phenomena are different, though the conclusion is the same. Each thus greatly strengthens the testimony of the other.

So much for the direct deductions from observation. Now, can this state of things be accounted for? It can, and the answer is one of the prettiest applications of celestial mechanics. It is a consequence of the disturbing effect of the nearer satellites of the planet upon certain particles of the ring, for all are not equally affected. Not only does proximity to the satellite play a part in all disturbance, but commensurability of periods between particle and satellite comes in for a curious role in the performance. To conceive it, let the reader imagine two bodies revolving round a third with different angular speeds. At some points in their orbits the two will approach closer to one another than anywhere else, and here the disturbing pull of the outer upon the inner will be greatest. If the periods of revolution of the two bodies are not commensurate, the two will return to conjunction at a different part of the orbits, and a certain compensation in the deformation of the orbits be effected. But suppose the periods bear a simple ratio to one another, two to one for instance; then conjunctions will occur in the same place over and over again, and the disturbances instead of being compensated will become cumulative and finally very great.

This action is exemplified in what is called the great inequality of Jupiter and Saturn, by which the place of Saturn may be out by as much as fifty minutes of arc; it is also shown by the gaps in the zone of asteroids due to commensurability of period with Jupiter; and lastly, it is instanced in the divisions of the rings of Saturn, Cassini's division and Encke's division being both due to this cause.

Now conceive a particle thus acted on by Mimas let us say, and to collide in consequence with a neighbor. The centers of the two will not probably be in the plane of the rings, because, however thin the ring, there are many particles in any cross section of it. There will therefore be a resultant throw out of the plane, and the particles will thenceforth travel above or below it. Such tossing of the particles out of their original level by satellite action will be most pronounced just inside the point where the perturbations are greatest. For at each collision there must be, as we saw above, a loss of *vis viva*, and the disturbed particles will eventually be found in consequence chiefly inside the line of maximum action.

According to this principle, let us see where we ought to find tores. For the analytical treatment of the subject, too technical of course to be given here, shows us which ratios are the most important, and these turn out to be the very simplest. The greatest disturbing ratio is when the periods of disturber and disturbed are as 1 to 2. This occurs in the case of Mimas, the most potent perturber of the particles of the rings, at Cassini's division. The first tore, then,

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should lie just within this or in the outer part of ring B. This is precisely where we find it. The next most powerful proportion is 1 to 3, also due to Mimas. This occurs at the boundary of B and C. The next tore then should be in the outer portion of ring C. This is where the second observed tore actually begins. But we saw that it was very broad, much broader than tore B. Now, the third most effective ratio is 1 to 4. And this in the case of Mimas takes place about two-thirds way in along ring C. Here then is a reason why that tore should be so broad. The only other case of commensurability of like importance is with Enceladus, the next outer satellite, and is as 1 to 3, and its action falls in Cassini's division, so that it helps Mimas to cause tore B. Here then is a very elegant exemplification of a case of celestial mechanics, that of commensurability of period. The tores in Saturn's rings observed and measured turn out to lie where deduction from the law of gravitation leads us to infer that they should be found.

Recent Flights by Farman and De La Vaulx.

BY OUR PARIS CORRESPONDENT.

On November 18 M. Farman made a formal trial for the Deutsch-Archdeacon $10,000 prize for the kilometer in a closed circuit, and while he did not succeed, the results were promising. He easily reached the turning post at 500 meters distance (1,640.4 feet), but he was not able to make the turn around it. On the last trial he made the turn, but he had touched the ground several times while doing so, although he succeeded in returning to the starting line while in flight. In this attempt the motor did not seem to be working well, which, according to M. Farman, accounts for the irregularity of the flight. Darkness stopped further trials for the day. Among the assembled crowd were noted Santos Dumont, Senator Henri Deutsch, Capt. Ferber, Messrs. Tissandier, Jacques Faure, Charron, Besancon, the secretary of the Aero Club, our correspondent, and one of the members of the editorial staff. Among the persons present was Mr. Orville Wright, who has been in Europe with his brother negotiating for the sale of their aeroplane, which is kept as close a secret as ever. Mr. Wright did not think it *apropos* to give his opinion at length as to M. Farman's performance, although he considered the flights as excellent and believed that Farman is in a fair way to win the Deutsch-Archdeacon prize, while being easily ahead as far as Europe is concerned. He has a high opinion of M. Farman's ability and thinks that his experiments are doing much to advance the progress in aeroplane work. M. Farman would be glad to compete for the Scientific American trophy, as he thinks he has already practically won it, and regrets that it cannot be competed for in France. On the same afternoon the airship "Ville de Paris" made its appearance, sailing over the grounds in fine style, and this, of course, added to the interest of the event. It was piloted by the aeronauts Henri Kapferer and Paulhan. After sailing about in several curves, it descended on the grounds during M. Farman's flights. Toward dark it rose up easily in the air, and returned to its headquarters at Sartrouville.

On November 23, for the third time, M. Farman once more competed for the Deutsch-Archdeacon prize. He was unable to make more than one attempt on this date, however, owing to a violent storm of wind and rain, which came on in the midst of the trial. After leaving his shed, in order to reach the starting point, he was obliged to make a flight across the field. Starting with the wind he crossed the field, described a semicircle, and landed against the wind, having covered a distance of 900 meters (2,952¾ feet). While preparations were being made for the flight for the prize, the wind suddenly veered and increased in intensity until it was blowing from 12 to 18 miles an hour. M. Farman, nevertheless, started his machine, and rose in the air at a high rate of speed. As the wind threatened to carry him beyond the limits of the field, he decided to descend and wait for better weather. The fact that he was able to maneuver the aeroplane and keep it on a fairly even keel under such adverse conditions, is another evidence of the inherent stability of this type of machine.

On November 19, while experimenting with his new aeroplane, Count de la Vaulx had an accident, which fortunately was without serious results. The aeroplane, which is of the monoplane type and has a total surface of 40 square meters (430 square feet), was being driven at about 30 miles an hour by its two propellers actuated by a 50-horse-power Antoinette 8-cylinder engine when suddenly one of the wings gave way, and the machine fell over upon the other wing. The front part of the machine dug into the ground, and the entire aeroplane turned upside down. Count de la Vaulx was hurled to the ground with great force, the motor falling on top of him and pinning him to the ground. To add to the danger, some of the gasoline caught fire, but the flames were quickly extinguished by onlookers. The Count fortunately escaped with a few cuts and bruises, though his machine, which he was trying for the first time to fly, was demolished.

The Experiments of M. Bordas in Producing Gems by Means of Radium.

An interview with M. Bordas, who has been reported as having produced various gems by the use of radium, is published in Le Temps of Paris. The New York Tribune summarizes the interview, showing that M. Bordas's work is not such as will revolutionize the jewelry trade.

The material of which a certain class of gems—rubies, sapphires, amethysts, and emeralds—consists is corundum. What M. Bordas has effected is merely an alteration in the color of the specimens with which he experimented, the change being attributed to the action of radium placed in close proximity to the stones. In this manner, it is announced, a white crystal was made to assume a yellow hue, a sapphire was turned from blue to green, and the tint of a pale ruby deepened. It was noticed, moreover, that if the exposure to radium was sufficiently prolonged the color of a ruby would change in succession to violet, blue, green, and finally to yellow. The interviewer shows that there is nothing in the transformations thus far observed which threatens to afford a supply of jewels produced inexpensively. He remarks reassuringly: "Let us rid our minds of the idea that M. Bordas has taken cheap stones—corundums and topazes—and elevated them to the dignity of gems—sapphires, emeralds, and rubies. Quite the reverse."

Though no intention of deceiving his hearers can be imputed to M. Bordas, the report of his recent experiments to the French Academy of Sciences was unfortunate in one particular. It was entitled "A Contribution to the Synthesis of Precious Stones." By "synthesis" the chemist means the putting together of certain elements for the manufacture of a substance having entirely different qualities. A molecule of grain alcohol, for instance, contains one atom of oxygen, two of carbon, and six of hydrogen. If man could persuade these ingredients to unite in the proper proportions and undergo the transformation which nature alone is able to bring about he would call the product "synthetic" alcohol. M. Bordas, it will be observed, makes no pretence of having effected a combination of materials for the production of something unlike the original elements. In each instance, according to his own statements, he began with corundum and ended with corundum. The only change he made was one in color. He has apparently not thrown any light on the synthesis of gems.

It has been supposed that the characteristic hues of the ruby, sapphire, amethyst, and topaz were due to the presence of metallic dyes in diminutive quantities. M. Bordas dissents from the accepted theory. He infers from his experiments that the differences represent differences in the degree to which the stones have been acted upon in the earth by substances possessing the properties of radium. All gems of the corundum class, he holds, were originally red. Those which by circumstances were well shielded from the influence of radio-active minerals retained their color. The amethyst, sapphire, and emerald indicate successive alterations, according to M. Bordas, while the topaz might be regarded as the ultimate product of the magic agency.

Though there is enough in this ingenious hypothesis to invite examination by persons who make a study of nature's processes, the practical importance of the work on which it is based is evidently small. The utmost which a jeweler could hope to do with the aid of radium apparently is to alter slightly the tint of a gem, but apparently an attempt to do so would be attended with uncertainty as to the result. Where there is a chance that a precious stone may be damaged, instead of being improved, the wisest policy would seem to be to let it alone.

The Death of Prof. Asaph Hall.

Prof. Asaph Hall, best known for his discovery of the two moons of Mars, died at Annapolis on the night of November 22. Prof. Hall was born in Goshen, Conn., in 1829, where he acquired a common school education. Surmounting great difficulties, he pursued his studies somewhat further, at Central College and at the University of Michigan.

In 1857 he began work under Prof. Bond in the astronomical observatory of Harvard, staying there until 1862, in which year he went to Washington to take the examinations preliminary to acquiring a post in the Naval Observatory. He passed these examinations, and was made an assistant professor of mathematics in the United States navy, being raised to the position of full professor in the January following. For thirty years he was attached to the Naval Observatory.

Many government astronomical expeditions were headed by Prof. Hall, and many important discoveries made by him, notably of the two moons of Mars in 1877. He was a member of the National Academy of Sciences, a foreign member of the Royal Astronomical Society of Great Britain, and held membership and offices in many other learned bodies.

Both Yale and Harvard universities conferred upon him the degree of Doctor of Laws, while Hamilton College made him a Doctor of Philosophy.

Retired from the navy in 1891, he was in 1895 appointed professor of astronomy at Harvard University.

Recent Awards of Scientific Prizes and Medals.

The American minister at Stockholm has advised the State Department that the Nobel prize for physicists has been granted to Prof. Albert A. Michelson, of the University of Chicago, because of his invention of an improved method of measuring the velocity of light.

The above mentioned honor comes almost on top of the Copley medal for optical investigation, which was awarded to him some three weeks ago by the Royal Society of England. Prof. Michelson is head professor of physics in the University of Chicago, of which faculty he has been a member since its founding in 1892. He received the Rumford medal from the Royal Institute of Great Britain, which made him an honorary member in 1899.

His first notable invention was an instrument for measuring the velocity of light, for an improved method of which he has now received the Nobel prize. He is also the inventor of a spectroscope that has a higher resolving power than any other instrument in use, and of several instruments for measuring distance by means of light waves. One of his most famous inventions is an interferometer, that not only measures light waves, but counts them as well.

The Nobel prize for chemistry has been awarded to Sir William Crookes, of London, while according to a dispatch to the Petit Parisien from Stockholm, it is stated that Dr. Laveran, of Paris, who is well known for his investigations of the propagation of tropical fevers by mosquito-conveyed microbes, has received the same prize in medicine.

The chief of the department of health and sanitation of Havana, Dr. Carlos Finlay, was recently presented with the Mary Kingsley medal in recognition of his discovery of the transmission of yellow fever by the mosquito. The Liverpool School for the Study of Tropical Diseases awards this medal in memory of Miss Mary Kingsley, the African traveler. Governor Magoon made the presentation at the University of Havana, before a large assemblage of officials and scientists, in his address congratulating the Cuban people on the great services that one of their countrymen had rendered humanity by remarkable researches in a field that entailed no mean personal danger.

The Davy Medal, founded one hundred years ago in honor of Sir Humphry Davy, has been awarded to Prof. Edward M. Morley, of West Hartford, because of his excellent determinations of the atomic weight of oxygen.

Changing Tints of Autumn Foliage.

The common idea regarding autumn coloring is that frost causes the brilliant color of the leaves. This popular fallacy is without any foundation in fact; frost has absolutely nothing to do with tinting of the leaves except that it hastens their fall. Autumn coloring is due to oxidation, which is caused by the action of light and heat, somewhat similar to the rust on iron. With leaves it is due to the fact that in fulfilling their mission they become choked by their own excretions, and the acids thus formed are acted on by the oxygen.

In extremely moist atmospheres the colors are not usually very bright, as in England, for example. And in very dry climates the leaves dry up suddenly, and their skin, which is very thick to prevent the escape of moisture, is not sufficiently transparent to allow of the color being seen beneath. In the regions where the autumn foliage is most vivid we find that an average season produces the finest colors. Neither a very dry nor very wet summer and early autumn will result in much brilliancy.

The extraordinary range of colors in trees of a single species is very noticeable, particularly so with the sugar maples; and it is remarkable that an individual tree will continue the same colors year after year; not only that, but the same branch will show the first tinge of color year after year.—Retail Druggist.

The Discovery of Ether Anæsthesia.

Active steps are being taken to honor the memory of Dr. C. W. Long, of Jefferson, Ga., the discoverer of ether anæsthesia. An act has been passed authorizing his statue to be placed in the statuary hall, Washington, D. C., and steps are being taken to have a suitable statue in position without any unnecessary delay. A marble statue forty feet high will be erected to his memory in Jefferson. The unveiling ceremony is to be performed by the president, for the time being, of the Georgia Medical Association, and is fixed for April, 1909. A suitable memorial building bearing a bronze tablet will be erected at Athens, Ga., on the site of Dr. Long's residence. The tablet will be inscribed with the date of Dr. Long's first operation and tell of his arduous and beneficent work in Athens.

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Correspondence.

Saliva as Antiseptic.

To the Editor of the SCIENTIFIC AMERICAN:

I would add a few lines to the observations of Charles A. Nash relative to the sterilizing effect of saliva. Surely one must indeed be blind who has not taken note of the tongue-lapping treatment our dumb animals give their wounds and lacerations, and with no other care such wounds heal in a remarkably short time. I have long since concluded that the best treatment for a wound is a liberal and frequent application of saliva taken from the glands under the tongue. This is a "home remedy" always resorted to with a cut or bruised finger; and while it may not appeal to our refined senses, nevertheless it is Nature's only salve, and may always be applied in the right place at the right time. O. J. REA.

Tracy, Minn., November 25, 1907.

The Marconi Company's Reply to Prof. Fessenden.

To the Editor of the SCIENTIFIC AMERICAN:

With reference to an article which appeared in your esteemed issue of November 16 last, over the signature of Prof. R. A. Fessenden, I am directed by Commendatore G. Marconi to inform you, for publication in your journal, that beyond denying generally the statements of Prof. Fessenden and dissenting from assertions made and conclusions arrived at in said article, he regrets that exigencies of business prevent him from entering into controversy on the subject, but that he simply invites reference to actual statements made by him before British and Italian scientific societies, for which statements he holds himself fully and solely responsible.

Com. Marconi desires me further to state that he intends to reserve detailed information respecting transatlantic wireless telegraphy for inclusion in papers which he has promised to read during this coming winter before American and British scientific societies.

MARCONI WIRELESS TELEGRAPH COMPANY OF AMERICA.
By J. Bottomley, Vice-President.

New York, December 3, 1907.

An Inventor Who Claims to Have Anticipated Mr. Edison's Concrete House Idea.

To the Editor of the SCIENTIFIC AMERICAN:

In No. 20, vol. xcvii, November 16, 1907, of SCIENTIFIC AMERICAN, I saw an article bearing the heading "Edison System of Concrete House." After reading over the article I notice that this system consists in the use of concrete pumped into adequate molds, same being spoken of as a new invention.

I must state, however, that the said process is not novel, as under date of December 14, 1901, patent No. 2498 was granted to me by the Mexican government covering a new process of manufacturing and building houses or the like in one piece, by means of specially designed molds that let the air escape. The same patent was improved on the 23d of March, 1903, under No. 3503 *bis*.

My system is still simpler than Mr. Edison's, as the mixer is suppressed.

I therefore claim as my own the prime idea of manufacturing concrete with a pump into adequate molds, this process being useful for the making of industrial products of every kind and description as well as for building houses, etc.

This invention might cause a revolution in the art of building, as construction may be carried out by the use of small pieces of material inwrapped in a semi-fluid mass playing the part of cement, with the object of uniting said material. The addition of iron bars or armature is a factor of security to the rigidity of the products thus obtained.

I am still further improving my process so as to make it more practicable. H. J. LECOMTE.

Mexico, November 26, 1907.

Sustained Flight at High Speed.

To the Editor of the SCIENTIFIC AMERICAN:

I read with considerable interest Mr. F. E. Stanley's letter concerning recent descriptions and data of flying machines which have appeared in your paper. For the most part I heartily agree with the writer, and it would seem that if the same sort of hard-headed common sense logic had been used by more of the flying machine inventors, less money would have been wasted and the art of flying would be much further advanced. Toward the end of his letter, however, he makes two statements which are substantially as follows: That with equal powers the speed of a flying machine will never be so great as that of a wheeled vehicle. Also that a flying machine can never carry a given weight of pay load as cheaply as a wheeled vehicle for a given distance.

His arguments to prove the first statement are based on the comparatively poor efficiency of the air propeller as compared to that of the driving wheels of a wheeled vehicle, and also on the supposition that the air resistance of a flying machine must necessarily be greater than that of a wheeled vehicle. The argument is good and rather hard to refute. The real weakness of Mr. Stanley's argument lies in the fact that he has apparently overlooked the possibilities of soaring, or gliding flight, as practised by most of the larger birds. This phase of aeronautics has from time to time been discussed in your valued paper. Perhaps one of the most exhaustive treatises on this subject is a paper by Octave Chanute which appeared in the Aeronautical Annual of 1896 and 1897. I feel sure that a careful consideration of this subject will convince any thinking person that it is at least possible to fly long distances at high speeds with little or no expenditure of power except that which is external to the machine or bird. I would also cite in support of this assertion the gliding experiments of Lilienthal, Herring, and the Wright brothers. As to the second of Mr. Stanley's assertions, relative to the comparative cost of aerial transportation, I must say that to attempt to refute it at present would be rather a hard task, although if we admit that less power is required to propel a flying machine at a given speed than a wheeled vehicle, we have quite a point in favor of the flying machine. HAROLD H. BROWN.

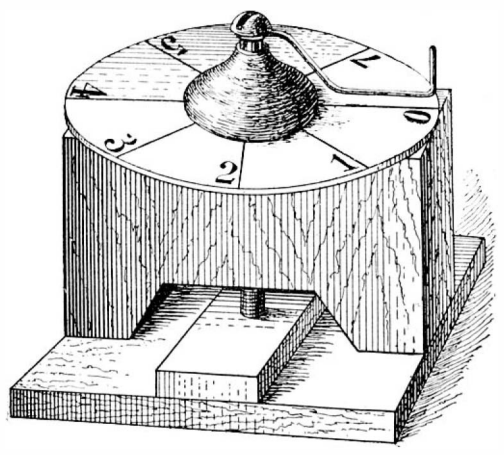
Boston, December 2, 1907.

AN EASILY MADE MICROMETER.

BY DR. THOMAS R. BAKER, ROLLINS COLLEGE, FLORIDA.

It often becomes necessary for the experimenter or practical worker to find the thickness of material so thin, or inconvenient to measure, that the thickness cannot be found by means of a foot-rule, or other common measuring device. A simple, fairly accurate, and easily-made apparatus of the micrometer form may be constructed as follows:

Get a common iron or brass bolt about ¼ of an inch in diameter and about 2½ inches long, with as fine a thread as possible, and the thread cut to within a short distance of the head of the bolt. A bolt with



A HOME-MADE MICROMETER.

a cut in the head for a screw-driver should be used. Clamp together two blocks of wood with square corners about 1 inch wide, ¾ of an inch thick, and 2½ inches long, with their narrower faces in contact (the width of the clamped blocks being two inches), and bore a ¼-inch hole through the center of the blocks in the 2-inch direction. Now remove the clamp, and let the nut of the bolt into one of the blocks so that its hole will be continuous with the hole in the wood, then glue the blocks together with the nut between them. Cut out a piece from the block combination, leaving it shaped somewhat like a bench, and glue the bottoms of the legs to a piece of thin board about 2½ inches square for a support. Solder one end of a stiff wire about 2 inches long to the head of the bolt at right angles to the shaft, and fix a disk of heavy pasteboard with a radius equal to the length of the wire, and with its circumference graduated into equal spaces, to serve in measuring revolutions and parts of revolutions of the end of the wire, to the top of the bench; put the bolt in the hole, screwing it through the nut, and the construction is complete.

The base is improved for the measuring work by gluing to a central section of it, covering the place where the end of the bolt meets it, a small piece of stiff metal; and it is convenient to have the graduated disk capable of rotating, so that its zero line may be made to coincide with the wire.

Find the number of threads of the screw to the inch by placing the bolt on a measuring rule, and counting the threads in an inch or half an inch of its length. The bolt in making one revolution will descend a distance equal to the distance between the threads.

To use the apparatus, put the object whose thickness is to be measured on the base under the bolt, and screw the bolt down until its end just touches the object, then remove the object, and screw the bolt down until its end just touches the base, carefully noting while doing so the distance that the end of the wire moves over the scale. The part of a rotation of the bolt, or the number of rotations with any additional parts of a rotation added, divided by the number of threads to the inch, will be the thickness of the object. Quite accurate measurements may be made with this instrument, and in the absence of the expensive micrometer, it serves a very useful purpose. I have used it in the beginning classes in electricity for measuring the diameter of wire, for finding the numbers of wires from reference tables, and for making various other measurements.

The Current Supplement.

Prof. George Lunge opens the current SUPPLEMENT, No. 1667, with a thoughtful article on the problems of applied chemistry. An apparatus for electrical vision is described under the title of the "Senlecq Telectroscope." A most helpful and practical article is one entitled "Some Soldering Appliances." Particularly timely at this season of the year is an article on preventing frost on show windows, in which article various methods of keeping glass clear in cold weather are described. William Mayner writes on some Prussian railroad tests made near Oranienburg, the object being to determine the best track. Frederick C. Coleman contributes a very interesting and excellently-illustrated article on a new cable ship, and describes the machines which are used for laying submarine cables. The action of sea water on concrete is discussed. The defects of the first British airship are enumerated in an article in which the need of harbors for aerial craft is dilated upon. For many years past pottery models of houses occasionally found their way into museums from the illicit digging of natives in Egypt, but nothing was known as to their original positions and dates, and they were so scarce that not even the National Museum at Cairo had any sample. Prof. Flinders-Petrie explains the meaning of these houses which, it would seem, had a peculiar religious significance. Few persons appear to be acquainted with the proper meaning of the word "coney" used in the Bible. Mr. R. Lydekker tells just what the coney is. Arthur Stentzel writes on the climate of Mars, and notes its effects upon the habitability of the planet.

Official Meteorological Summary, New York, N. Y., November, 1907.

Atmospheric pressure: Highest, 30.55; lowest, 29.16; mean, 30.04. Temperature: Highest, 60; date, 2d; lowest, 33; date, 30th; mean of warmest day, 54.5; date, 6th; coolest day, 36.5; date, 14th; mean of maximum for the month, 50.1; mean of minimum, 40.4; absolute mean, 45.2; normal, 43.8; excess compared with the mean of 37 years, +1.4. Warmest mean temperature of November, 50, in 1902. Coldest mean, 37, in 1873. Absolute maximum and minimum of this month for 37 years, 74 and 7. Average daily deficiency since January 1, —1.0. Precipitation: 5.05; greatest in 24 hours, 1.90; date, 6th and 7th; average of this month for 37 years, 3.50. Excess, +1.55. Accumulated excess since January 1, +0.19. Greatest November precipitation, 9.82, in 1889; least, 0.82, in 1890. Wind: Prevailing direction, west; total movement, 8,699 miles; average hourly velocity, 12.1 miles; maximum velocity, 52 miles per hour. Weather: Clear days, 8; partly cloudy, 9; cloudy, 13; on which 0.01 inch or more of precipitation occurred, 11. Snowfall: Trace. Mean temperature of the past autumn, 55.17; normal, 55.20. Deficiency, —0.03. Precipitation for the same season, 16.87; normal, 10.89. Excess, +5.98.

A New Anæsthetic.

Mr. F. W. Malvin, United States consul at Nottingham, sends to the Bureau of Manufactures at Washington some particulars concerning the new anæsthetic, stovaine. It appears that it produces paralysis of the body below the point of injection and removes all sensation from the limbs, so that it has been found possible to amputate a man's leg while the patient retained consciousness, and could, had he been allowed to do so, have even witnessed the operation. The patient could feel no pain, and after the operation and when sensation returned experienced nothing but the sense of bruising, which is one of the sequels of grave operations. The curious name of the anæsthetic, "stovaine," is due to its discoverer, M. Fourneau. M. Fourneau was anxious to perpetuate his own name in connection with it, but as the anæsthetic was of the nature of cocaine and no compound resembling that could be contrived out of "Fourneau," he translated the name into its English equivalent of "stove" and added the necessary termination.

As the accuracy with which drill bits are formed and sharpened has a great influence on the capacity of a rock drill, and also as the maintenance of drill steel is one of the most important items in the cost of rock drilling, experience has shown that all mines using a considerable number of drills should include one or more drill-sharpening machines in their equipment. Drills sharpened by machinery are more perfect than those sharpened by hand, and the saving in cost will in a short time pay for the machine. The saving in labor alone is estimated as amounting to at least 65 per cent.

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A GLIMPSE OF WESTERN TIBET—AN AUSTRIAN EXPEDITION TO THE FORBIDDEN LAND.

BY DR. ALFRED GRADENWITZ.

Situated between Asiatic Russia and British India, bordered on the south and west by the Himalayas, Tibet is one of the most interesting and little known of any Asiatic country. Its geographical situation as a kind of buffer state between the two great European countries with large Asiatic interests has given it a certain importance in the political world; and general interest has been excited by the nature of the land and the character of its natives, both of which have combined to keep out explorers. For the land is a high plateau—much of it higher than the summit of Mont Blanc—cold and barren; and the people regard it as almost a part of their religion to keep the foreigner away. Explorers have from time to time traversed parts of the country, and some of the districts bordering on British India have learned to welcome sportsmen, but Lhassa, the capital city—the holy city—had never been trodden by the foot of any European, until in the spring of 1904, when a British military mission arrived there, and some of its members entered the city. Though the latter thus lost some of the charm of mystery which formerly attached to it, the treasures stored up within its walls—treasures accumulated by centuries of student priests—are far from having been made accessible to scientific investigation; indeed, in spite of occasional visitors, practically all Tibet is virgin ground for the scientific and geographical explorer.

Until its annexation to the Chinese Empire, more than a century ago, Tibet had an independent history. Its population, while being of Mongolian race, is strictly different from the Chinese, as evidenced by its language and the alphabetical system of writing. The country has played an important part in Asiatic civilization, having been the cradle of Buddhism, and being still one of the strongholds of this religion.

In spite of the British expedition of 1904, the country is in some respects more exclusive than before, for ingress from the Indian borders is now forbidden by both governments. To penetrate it from the east is extremely dangerous and difficult, owing to the nature of the long stretch of country to be traversed, and the only possibility of entering the country is by the northern route from Russian territory.

This route has been followed by a Viennese zoologist, Dr. Erich Zugmayer, who last year undertook an expedition of discovery to western Tibet, and to whose courtesy the writer is indebted for many of the facts exposed in this article, as well as for the reproduction of some photographs taken by him. The northern provinces of the country, through which Dr. Zugmayer had to pass on his way from Siberia and Turkestan, are sparsely populated, while the Chinese frontier is open to anybody. In those tracts, which have hardly ever been visited by European travelers, one is at liberty to carry out any scientific investigations, unhampered by any foe other than Nature, which indeed is an extremely dangerous foe. The whole of western Tibet is at an altitude of more than 15,000 feet, and in summer time the snow limit on the mountains is less than 2,000 feet higher. In these high altitudes the frequent storms, the severe cold, and the thin air of the highlands, as well as the absence of sufficient food for animals, will tax the energy of travelers to the utmost. The beasts of burden of the caravan succumb to the fatigues of the journey at about the rate that the grain they carry is exhausted.

When the high plateaus, with their passes and higher ridges covered with perpetual snow, are left, and the inhabited regions are visited, the difficulties opposed by Nature tend to disappear as the expedition arrives at lower altitudes and milder climates. The hampering influence of the native population, however, is felt the more strongly, as the nomad tribes, which are at first encountered, show a most obstinate passive resistance, due partly to the fear of authorities and partly to their innate distrust of Europeans. According to the descriptions of many travelers, the national characteristics of Tibetans are very far from sympathetic, extreme haughtiness on the one hand and great servility on the other being their most striking traits.

These nomads, forced to wander to find scanty pasturage for their cattle, are an unprepossessing people. In its exclusiveness Tibet seems to have withdrawn even from itself, and its people are divided into many tribes or clans, neighboring villages often having a widely differing dialect. The people are swarthy, with coal-black eyes and hair, and as the men walk about half naked when the days are warm, with enormous spears slung over their backs and often a rusty flintlock in their hands, they look bold and picturesque. But at close range they appear cowardly and filthy. The women, as in many savage tribes, are the workers, and soon lose any comeliness which they may have when young. Tea, butter, and barley meal are staple articles of diet. Tea is a national institution and bricks of it—for it reaches Tibet in the shape of small compressed bricks—are used as currency. The nomad tribes pitch a tent of yak hide, some 20 by 30 feet or more; and closing it on all sides except one narrow hole, which serves for door, window, and ventilation, herd for warmth round an oil lamp. Animals share the shelter with the people, and the atmosphere of a tent soon becomes indescribable. It is extremely difficult to induce native tribes to sell any beasts of burden, especially yaks, severe penalties being incurred by assisting a European caravan. The yak, which is the main beast of burden of Tibet, though being slow and stubborn, is far more useful than the horse, especially in traversing mountain passes, owing to its enormous strength and great frugality. It is able to carry loads of 100 pounds without needing other food than the coarse grass, tamarisk leaves, or lichens, which it gathers on its way. It is furthermore an excellent climber, and is practically insensitive to storm and cold. However, there is nothing this animal is less able to stand than sudden changes of climate, and in this respect it is said to be inferior to sheep.

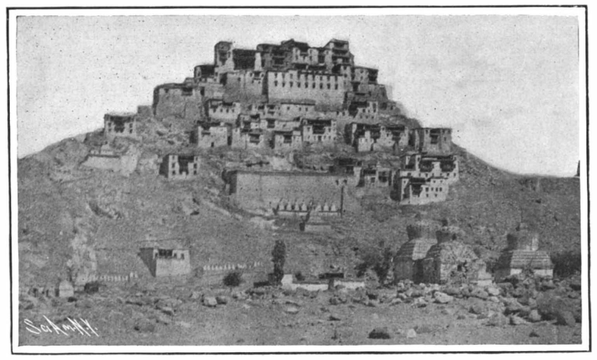
Good pasturage is rarely encountered in the elevated northwestern parts of Tibet. When it is found, the people camp, and a day's journey is from oasis to oasis, the more so as some water and fuel (consisting mainly of the excrements of wild yaks and antelopes) are nearly always found in these spots, which are often fairly well protected against winds.

Throughout western Tibet the region of everlasting snow is soon reached in ascending mountain passes, which are permanently covered with deep layers of snow. At somewhat lower altitudes, however, the heat of the day makes itself felt, and as snow and rain are scarce, the highlands contain only a few glaciers. Beyond the parting of waters toward Cashmere, glaciers, owing to the influence of the moist southerly winds, are found more frequently, in spite of the higher temperature and lower altitude.

The monasteries of Tibet have been centers of learning for centuries, and to-day may be likened to the medieval cloisters of Europe, the more so as they generally constitute real forts, under the shelter of which settlers will establish their abodes. These monasteries are frequently found on isolated mountains, being sometimes built into them and utilizing their natural cavities. The stone walls of the country, designated by the term of "Mani," contain numbers of slate slabs with the sacred inscription "Om mani padme hum," especially in the neighborhood of monasteries. Other characteristic constructions are the pillars of faith, or "Tshorts," which though corresponding to Christian chapels, do not contain generally any altar, but merely some relic. It is considered a pious action to walk many times (and frequently hundreds of times) around them. These curious outcomes of local religiosity illustrate the strange manner in which religion in this country often manifests itself. It is mainly due to the influence of the priests or lamas, who are the predominant caste, that existing conditions are altered as little as possible, Tibet having so far been protected practically entirely against the invasion of foreign ideas and views.

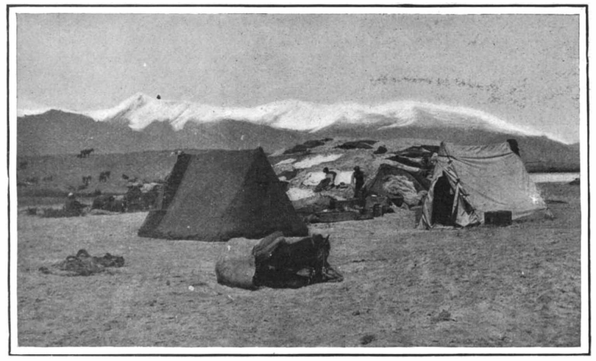
Dr. Zugmayer was able to penetrate into the interior of the monastery illustrated, and unheeded by the priests, succeeded in taking the inside view which is reproduced. The pedestals visible in the figure are of cedar coated with gilt metal and precious stones, the lions are paintings, the idols are of bronze or copper, and the vessels of silver, bronze, and porcelain. A group of small silver cups contain offerings in the shape of sugar, flour, rice, and water.

Curious Tibetans Waiting to See the Foreigner.



A Typical Monastery Perched on a Commanding Site.

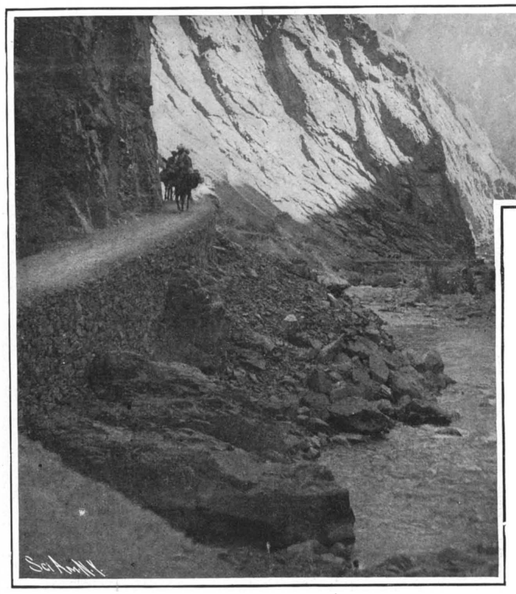
Tibetan Girls.



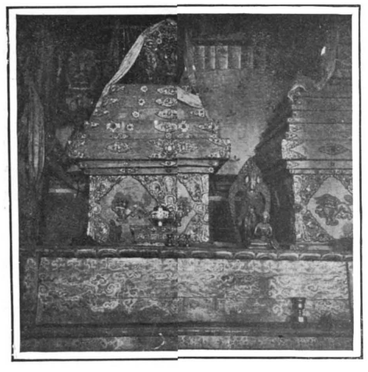
The Camp Pitched on an Oasis.

A Nomad Family and Their Tent.

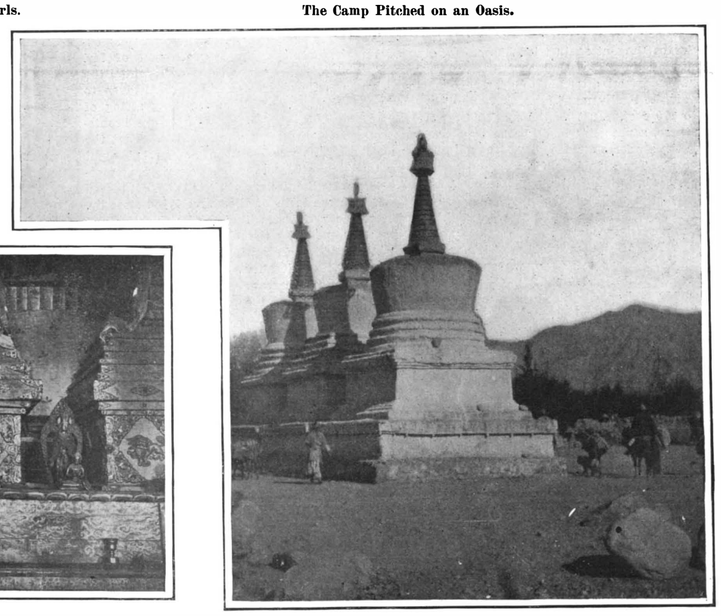
The Garrison of a Tibetan Town on Parade.



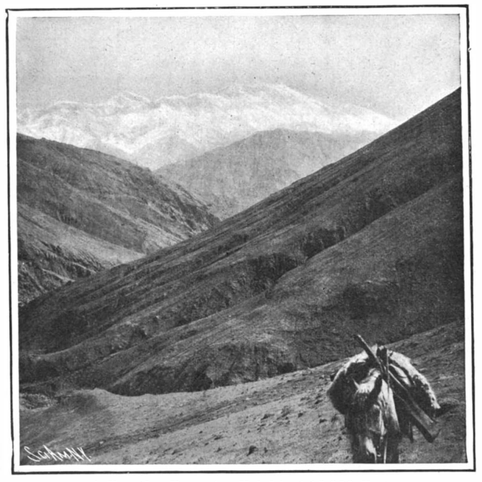
One of the Safer Roads of Tibet.



A Shrine in the Monastery Shown Above.



"Pillars of Faith" Which Usually Contain Some Relic.



A Frontier Pass at a Height of 16,000 Feet.

A GLIMPSE OF WESTERN TIBET.

Expedition to Philippine Waters.

An extensive exploration of the waters about the Philippine Islands is soon to be made under government auspices. The expedition is in charge of Dr. Hugh M. Smith. The object of the investigation, which will probably cover a period of three years, is to discover just what food fishes, edible crustaceans, what pearl fisheries, sponges, and other valuable water life the Philippine waters possess, and then to show the natives how they can develop their industries, and particularly how they may secure a large internal commerce by catching fish for settlements off the coast. At present, only people of the coast towns eat fish, and the fishermen catch only enough for each day's use. It is expected that many new kinds of edible fish will be discovered, of which the natives know little or nothing. The natives will then be instructed how best to take these fish, and what methods to use in preparing them for market or export.

SANTOS DUMONT'S LATEST AEROPLANE.

BY OUR PARIS CORRESPONDENT.

No one at home or abroad has shown so much energy in the solution of the questions of high-speed air and water navigation as Santos Dumont. The rapidity with which he changes from experimentation with an aeroplane to skimming the water with a hydroplane, and then back again to an aeroplane, is truly amazing. If the hydroplane does not succeed, or if the aeroplane gets smashed, he is soon afloat or afield again with a new and improved apparatus. Only a short time ago we illustrated his hydroplane, and now we take pleasure in showing our readers his latest aeroplane, with which he has signified his intention of competing for the SCIENTIFIC AMERICAN trophy.

This latest aeroplane, which is Santos Dumont's nineteenth machine, is the lightest and simplest flyer which he has thus far produced, which accounts for its rapid construction in two weeks' time. Instead of having double surfaces, as did all his previous aeroplanes, "No. 19" is a monoplane made up of two wings set at a dihedral angle. This monoplane is 5.1 meters (16.73 feet) long (spread of the wings) by 2 meters (6.56 feet) wide (from front to back), and it is mounted upon a suitable framework of steel tubing, which is in turn carried upon three pneumatic-tired wheels that are slightly inclined outward, so that they are farther apart at the bottom than at the top. A combined lozenge-shaped horizontal and vertical rudder is mounted, by means of a universal joint, upon the end of a 20-foot bamboo pole that projects behind, while a small horizontal rudder is also fitted in front. Two lozenge-shaped stabilizing rudders are placed nearly vertical, one on each side of the supporting framework, and are arranged to work in unison with the rudder at the rear when moved by a single handle, which, when it is moved in another direction, also operates the horizontal rudders. Both the rudders and the wings of

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the aeroplane are made of plain white silk tightly stretched over the ribs of the wooden framework, which is slightly inclined upward from rear to front.

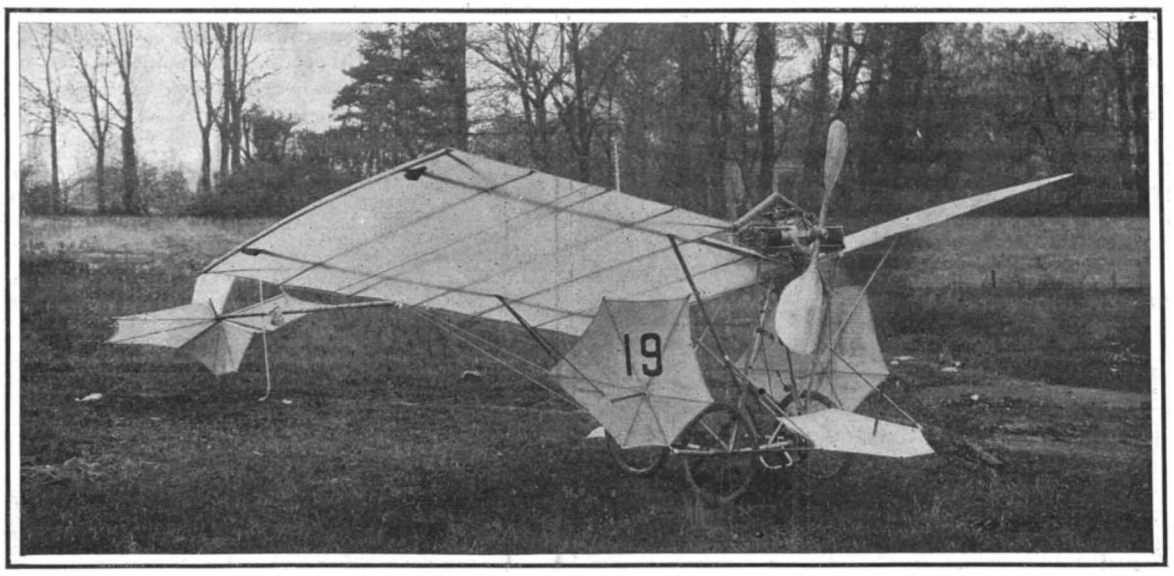
The motor is far simpler and considerably less powerful than the 8-cylinder, V-type, water-cooled engine with which Santos Dumont first flew over a year ago. It is a double-opposed-cylinder gasoline motor of the air-cooled type, capable of developing from 17 to 20 horse-power. As can be seen from the illustrations, it is mounted at the front edge of the aeroplane, and carries a 2-bladed, 4½-foot propeller directly on its crankshaft. The pitch of the propeller is 1.05 meters (3.44 feet), and the blades are oval and concave. The motor was designed and built in ten days by the engineers of the Duteil & Chalmers Company, of Paris. Its weight is but 22 kilogrammes (48½ pounds), or about 2½ to 2¾ pounds to the horse-power. The gasoline tank is very small. It holds only one liter (about a quart), and is fastened at the rear of the monoplane.

The seat for the aviator consists of a small saddle suspended from the framework below the aeroplane. The controlling handles for the rudders and engine are conveniently placed in front of the operator.

As already stated, the whole apparatus is carried on three wheels placed underneath the chassis, and there is also a supporting piece fixed under the middle of the bamboo pole. What is remarkable about the new flyer is its small size and its compact appearance. It is much smaller than most of the aeroplanes which have been built recently. The total overall length of the machine from front to rear is 8 meters (26.24 feet). The weight is also remarkably low, and it would be difficult to construct an aeroplane much, if any, lighter, as it weighs only 56 kilogrammes (123.45 pounds) for the complete apparatus, and 110 kilogrammes (242½ pounds) when mounted by Santos Dumont. The total sustaining surface of this aeroplane is about 107 square feet, so that each square foot is loaded to the extent of 2¼ pounds when the weight of the aeronaut is included. The weight lifted per horse-power is about 14¼ pounds. During the first flights which were made with his new monoplane on November 17 in the Bois de Boulogne, M. Dumont was well satisfied with its performance, about which he spoke as follows: "I had the aeroplane well under control, and never had such a great sensation of security, even in my airships. During these experiments I did not yet work the rudders, but by shifting my body to the right or left, the apparatus had a tendency to follow this movement by turning in the corresponding direction. The flight was stopped by a somewhat curious accident, that is, a lack of gasoline, as the tank had not been filled up after the first tests, so that the motor came to a stop and the flyer pointed head down; but as I was then sailing about twenty feet high, I had time to rise up again by working the horizontal rudder, and was able to come down easily on the ground." Owing to the breaking of a wheel, the tests were stopped for that day. Santos Dumont then made his formal entry at the Aero Club in order to compete for the Deutsch-Archdeacon prize of $10,000 on the following day. To do this the aeronaut must fly across the starting line—which line is determined by two poles placed 50 meters (164 feet) apart—and then make the turn about another post situated at 500 meters (1640.4 feet) upon a line running from the middle point of the starting line and at right angles to it. After making the turn, the aeronaut must come back and cross the line while in full flight.

The trial was accordingly carried out the next day at the drill grounds of Issy les Moulineaux, on the outskirts of Paris, with the posts planted and the official timekeepers present. There were many prominent aeronauts assembled, such as Messrs. Archdeacon, Henri Deutsch, Delagrange, Tatin, Henri Farman, Capt. Ferber, and two representatives of the Scientific American.

After making a preliminary run upon the ground, he made a fine flight of three hundred feet or more at twenty feet height; and then a second flight of about the same distance, keeping at fifteen feet from the ground. The best performance was a flight of 450 feet made quite near the ground, during which he changed the height from five to six feet at will by means of the horizontal rudders. After changing the direction of the posts so as to bring the wind dead ahead, he attempted to make an arc of a circle, being part of the time in flight and the remainder on the ground; but after several attempts of this kind he found that he was hindered by the faulty working of the carbureter, which was at too high a level for the gasoline to flow into it properly. For this reason he was obliged to finish the test for that day. Henri Farman expected to begin work the next day, so that it was agreed that the two aeronauts should compete for the prize on alternate days.



Three-Quarter Front View of the Aeroplane, Showing the Horizontal and Vertical Rudders in Front and the Combined Rudders at the Rear.

On November 21 Santos Dumont again tried his machine in the presence of the Aero Club committee. After two or three unsuccessful attempts to get the aeroplane up in the air, he finally made several short flights of from 90 to 120 feet. Just as the machine landed after one of these, a propeller blade broke off, and, hurtling through the air for a distance of 393 feet, buried itself in the turf. The aeroplane fell over on one wing and stopped abruptly. Although Santos Dumont escaped injury, the motor broke loose, and the machine was rather badly damaged.

TEST OF THE BELL AEROPLANE.

On the sixth instant Dr. Alexander Graham Bell's tetrahedral-cell aeroplane was successfully flown as a kite above the Bras d'Or lakes at Baddeck, C. B. The aeroplane carried ballast representing a man and motor. It rose in the air easily when towed at a speed of about 15 miles per hour. Dr. Bell was entirely satisfied with the result of the test, which was made before fitting the aeroplane with a motor.

A CARNIVOROUS DINOSAUR: A RECONSTRUCTED SKELETON OF A HUGE SAURIAN.

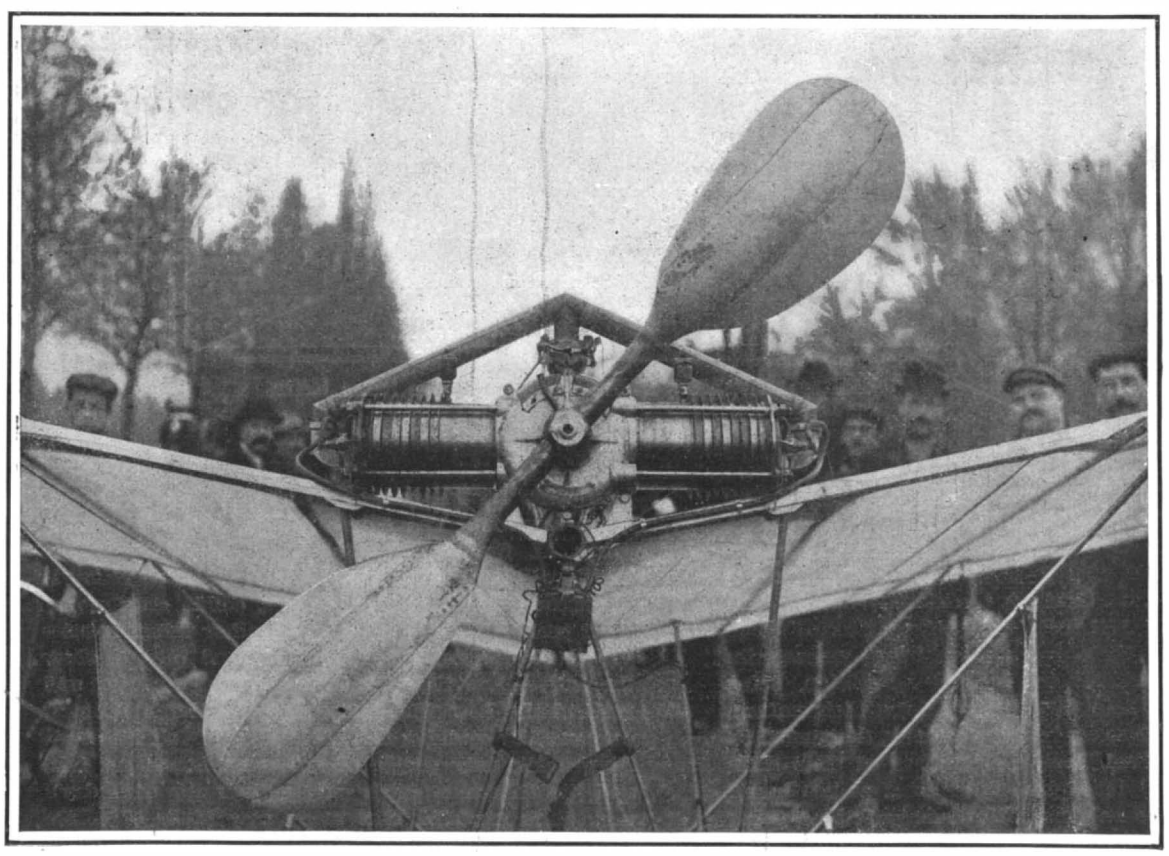
BY WALTER L. BEASLEY.

There is now on exhibition at the American Museum of Natural History, New York, a skeleton of a large carnivorous dinosaur. Following the policy of the museum, Prof. Henry F. Osborn, who is responsible for this reconstruction, has departed from the traditional methods of mounting, for the flesh-eating animal is here poised as feeding upon the vertebræ of his victim, a huge brontosaurus, a herbivorous contemporary considerably larger than his carnivorous foe. These bulky, slow-moving brontosaurs, seventy to eighty feet long, without any armor or apparent means of defense, were hopelessly outclassed and probably easily overcome in battle by the fierce allosaurs. Additional interest surrounds this specimen, as large carnivorous dinosaurs are exceedingly rare. Though three or more distinct types of great dinosaurs lived at the same time and in the same region, the remains of the herbivorous ones have been the most frequently discovered, while the flesh-eating dinosaurs have been found only in a few instances. In this mount, Prof. Osborn, to whose courtesy we are indebted for much of the information here given, has scored a twofold paleontological triumph in the innovation of representing a fossil skeleton in action, and in the fact that this is the first giant carnivorous dinosaur of this type to be mounted and exhibited. In referring to the composition and departure from the customary scheme of mounting, Prof. Osborn made the following statement to the writer regarding this specimen:

"Since the allosaurus skeleton was found in the same bluff as the brontosaurus, namely, the Como Bluffs of Wyoming, and not very far away, it is barely possible, although very far from being a demonstrated fact, that this very allosaurus preyed upon this very brontosaurus skeleton. However this may have been, it is absolutely sure, judging by the intervals between the tooth marks, that a certain allosaurus did prey upon this brontosaurus, and we are justified therefore in bringing the two skeletons together. It is the first time that a fossil animal has been mounted standing over its fossil prey."

A vivid picture of the final scene of such a combat between the two titanic reptiles, the flesh eater and the massive "thunder saurian"—brontosaurus—is obtained from the accompanying reproduction of Mr. Charles R. Knight's water-color drawing, while the photograph shows the characteristic attitude given to the mounted skeleton, as well as the long string of vertebræ, pelvis, ribs, etc., of the overthrown brontosaurus, beneath the feet of the allosaurus. That the beast waged constant warfare upon, and probably put to death its other still larger herbivorous contemporaries, is shown by the finding of their bones all scored and bitten, with the teeth of allosaurus lying close by. A section of the vertebræ with the deep furrows and actual imprints made by the teeth of the allosaurus is shown in one of the accompanying photographs.

In the mount the allosaurus is represented in the act of devouring the carcass of brontosaurus. The head is raised a little, and the fore limbs partly lifted in defiance-like attitude, as if to ward off other animals who might wish to share in the feast. This alert creature was built for speed and strength, as well as for fighting erect; using the very long, powerful hind



Front View, Showing Double-Opposed-Cylinder Motor and Propeller on Its Crankshaft.

SANTOS DUMONT'S LATEST AEROPLANE.

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limbs, to advance by walking or running, in making an attack upon the most vulnerable parts, probably the throat, of the large dinosaurs. In erect attitude it is estimated the head was about twenty feet above ground. The massive hind limbs, eight feet long, with their huge claws, were well adapted to support the enormous frame and to hold down the body of its prey. The short fore limbs, three feet in length, with their immense claws, were used exclusively, it is thought, for attacking and tearing off the flesh of a victim, and not for support. The heavy tail, twenty feet long, served to balance the body. A vivid idea of the size of the enormous claws and their flesh-tearing qualities can be judged from the illustration, with the head of a man underneath, one of the claws being twelve inches long. The skull was three feet in length, and many of the tiger-like teeth measured three inches.

This skeleton is thirty-four feet in length and eight feet three inches in height, and is one of the treasures of the famous Cope Collection, presented to the Museum by Morris K. Jesup, Esq., the president of the Museum, in 1899. The skeleton was discovered by F. F. Hubbell, a collector for Prof. Cope, in October, 1879, in the Como Bluffs near Medicine Bow, Wyoming, and not far distant from the famous Bone Cabin Quarry, opened by the American Museum, which has yielded the greatest number and variety of dinosaurs of any one spot in the world. Here, by geological uplifts in the distant past, the earth has been thrown into a series of great rock waves or folds. In the downfolds of these, extending to some two hundred and seventy-four feet in thickness, has been found to exist a wonderful layer of entombed dinosaurs of enormous size. The allosaurus was taken to Philadelphia, where it remained in storage in the basement of Memorial Hall for over twenty years until purchased by Mr. Jesup, who paid $50,000 for the whole collection. In 1899, after the purchase, Dr. W. D. Matthew, the Associate Curator, went to Philadelphia under instructions from Prof. Osborn, to superintend the packing and removal of the collection to the Museum. The boxes were still piled up just as they came from the West, and had never been unpacked, except in a few instances. It was thought that the Hubbell collection was not of any great value, as his letters from the field had not been preserved; and as some of his earlier collections had been fragmentary the balance was supposed to have been of the same nature. When the collection was unpacked at the American Museum, this lot of boxes, which was regarded as of little interest, was not opened until 1903. When this specimen was laid out for examination, it was recognized as a prize. Although collected by the crude methods of early days, it consisted of nearly a complete skeleton, with the bones in wonderfully fine preservation. They were dense black, hard and uncrushed, even better preserved and somewhat more complete than the few specimens of the allosaurus obtained from the Bone Cabin Quarry. By comparison and study of the three allosaurus skeletons, with assistance and details from others, the missing bones were reconstructed and the few missing parts were carefully adjusted by Dr. Matthews. Nearly four years, at intervals, were devoted to the preparation of the skeleton. The mounting was accomplished by Mr. Adam Herrman and his assistants, Messrs. Falkenbach, Lang, and Schlosser. Mr. Otto Falkenbach modeled in the missing parts.

Modeled by Charles R. Knight.

The Size of the Allosaurus Compared With a Horse.

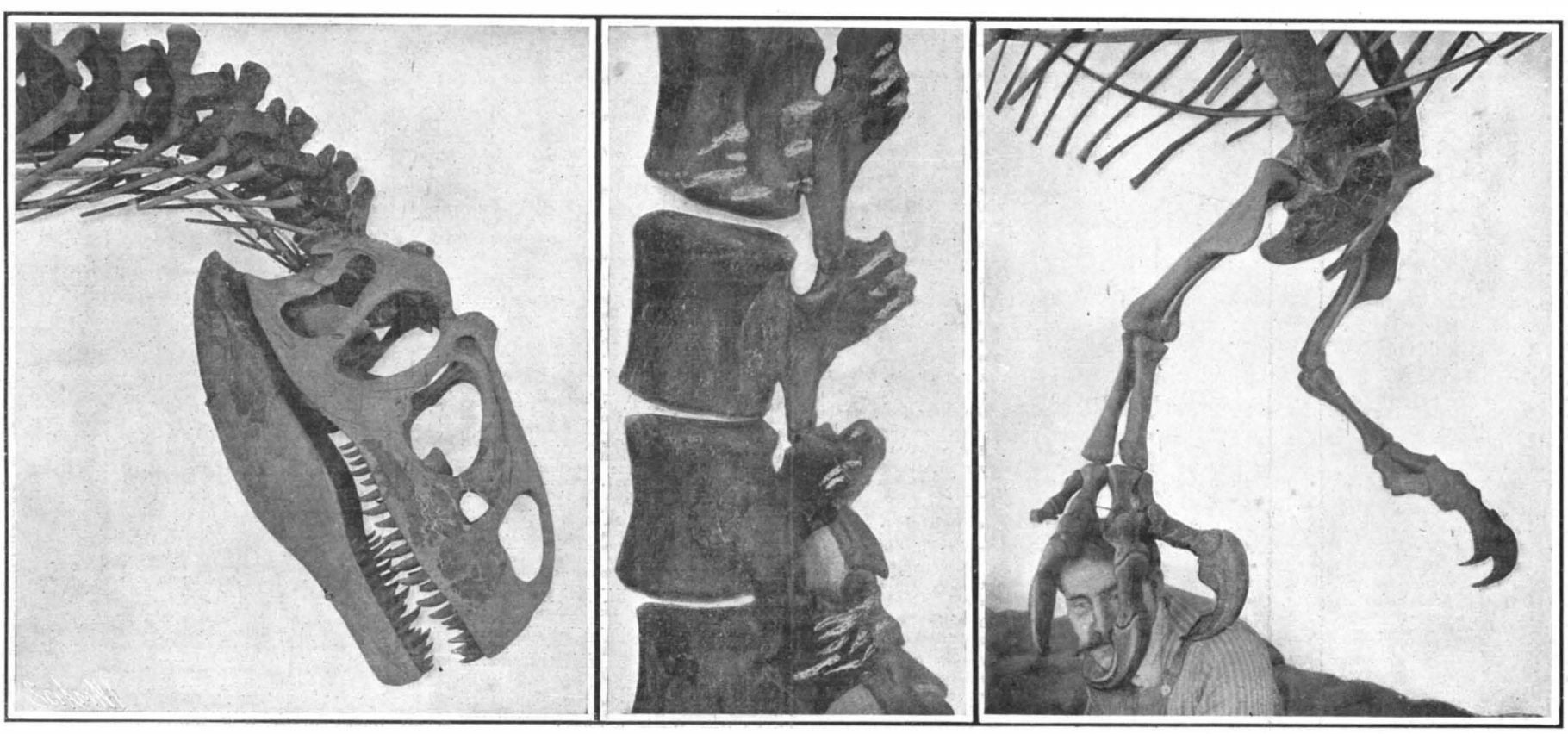
The American consul general at Cape Town, South Africa, is establishing a commercial information bureau and reading room in order to promote the sale of our goods in the surrounding region. The intention is to furnish to prospective buyers accurate information with regard to the nature, quality, price, and the like, of every class of exportable commodity produced in this country.

Circulars are being distributed in the territory to be covered bringing the bureau to the attention of those likely to be interested, and inviting correspondence.

It is hoped that American manufacturers will take advantage of this opportunity to easily enter the rich field opened to them and that they will send to the consulate their catalogues, price lists showing wholesale and retail discounts for goods to be exported, and all other useful information that they possess.

Another Eruption of Vesuvius.

After two months of inactivity, Mount Vesuvius is again emitting clouds of smoke from three fissures around the old crater. Much rumbling and roaring is also heard. Because of the late earthquake in Calabria, some alarm is felt, for the great eruption of April, 1906, followed after the Calabria earthquake in 1905.



The Three-Foot Skull and the Large, Tiger-Like Teeth of the Allosaurus.

Teeth Marks on the Vertebrae of a Brontosaurus.

The Short Fore Foot of the Allosaurus, Showing the Huge Size of the Claws.

A CARNIVOROUS DINOSAUR.

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RECENTLY PATENTED INVENTIONS.

Electrical Devices.

INSULATING-FIXTURE. — L. STEINBERGER, New York, N. Y. Mr. Steinberger's invention relates to an insulating fixture adapted for use in connection with arc lights; also as a suspension device in connection with span wires, and is especially serviceable as an insulating support and strain member, and may be employed as a turn buckle. It may be used in a variety of ways for insulating conductors, and is well adapted to act in combination with other fixtures.

Of Interest to Farmers.

IRRIGATING OR DITCHING PLOW.—M. JACKSON, Mabton, Washington. The object of this invention is to produce a plow which is especially adapted for making ditches, for clearing ditches already constructed or for cultivating between the rows of corn, potatoes, etc. The construction enables a plow to have a knife attached thereto for cutting away roots of weeds and similar growth between the rows when the device is used as a cultivator.

COTTON-CHOPPER.—G. M. HEAD, Marianna, Ark. The invention pertains to cotton thinners or choppers adapted to be used by cotton planters for thinning or blocking out the rows of growing cotton. The object is to produce an implement which may be advanced by a draft animal down the row of growing cotton; the construction being such that the implement operates automatically to thin out or chop out parts of the growing plant.

Of General Interest.

TOBACCO-PIPE.—E. VALLANCE, New York, N. Y. In this instance the object of the improvement is to provide a means for cleaning the interior of the pipe-bowl. In operation, for cleaning the pipe, the rotating part is to be rotated, which will rotate the blade in the pipe body, thus effectually cleaning the same of incrustation that may be therein.

BEER-TAPPER. — R. B. SPIKES, Bisbee, Ariz. Ter. The invention is in the nature of a new beer tapper, for use in simultaneously drawing beer from a barrel and admitting compressed air, and it consists in a novel construction and arrangement of tapping devices, part of which are permanently fixed in the barrel, and part retained at the bar or dispensing place and are applied by the barkeeper by being coupled on to the permanently attached members on the barrel.

AMALGAMATOR.—G. E. PAULLINS, Colorado Springs, Col. The amalgamator is an apparatus for use in extracting gold and silver from refractory ores, a portion of these metals being converted into amalgam with mercury in the receptacle into which pulverized ore is delivered and wherein it is treated mechanically and electrically, and the fine ore separated from such metal in the free state being removed by mechanical means.

SPRINKLER.—G. BUELNA and A. R. POETT, Santa Barbara, Cal. The invention relates to sprinklers as used in sprinkling lawns, etc., relating to those which are placed at any point of the lawn and automatically revolved by the reactive force of the water and throwing the same thereabout. It is adjustable to throw a spray at any angle, thereby increasing or decreasing the radius at which the major part of the water falls; or, the angle may be changed 180 degrees, in which case the rotation will be reversed.

PIANO-PROTECTING PAD.—KATHERINE M. KEOWEN, New York, N. Y. The invention refers to improvements in devices adapted to be used in connection with pianos or other similar instruments to protect the front panel from being accidentally marred or damaged by the shoes of the player. The object is to construct a device compact and complete in itself which may be very readily and easily applied or removed and which does not mar or injure in any way the piano on which it is used.

INSTRUMENT FOR USE IN DETERMINING THE FUNCTIONS OF CIRCLES.—A. S. H. HITCHINGS, Rio de Janeiro, Brazil. Many attempts have not solved the problem of "squaring the circle" except by methods of approximation. They have not been strictly accurate mathematically. While this inventor does not claim to have supplied this deficiency, yet he has succeeded in producing certain geometrical constructions which have provided him with means for forming an instrument for use in determining the area and circumference of a circle from a known diameter.

Hardware.

RAZOR.—L. HEUSER, New York, N. Y. The inventor provides a razor with a blade adapted to be detachably secured to a shank, and constructed of thin, flat metal adapted to be readily ground at its edge thereby avoiding the expensive operation of hollowing out the sides of the razor blade by the grinding process, which frequently results in drawing the temper to a greater or less extent and preventing blades from being tempered in accordance with a uniform standard.

Household Utilities.

WATER-CLOSET LID AND DEVICE FOR PREVENTING SEATS FROM SPLITTING AND WARPING.—J. E. ALBRIGHT, Greensboro, N. C. This invention is applicable to closet lids or covers as well as seats. The closet seat has a continuous circular groove in its inner side, a circular metal hoop is arranged in the groove, the normal diameter of the wire being slightly less than the diameter of the groove. Thus the hoop when expanded under influence of heat, is of sufficient diameter for insertion in the groove and then upon cooling grips the inner wall of the groove by contractile force induced by lower temperature.

COMBINED KNIFE AND FORK.—W. R. BROWN, Tidioute, Pa. The object of the invention is the production of an article which will carry a knife blade and a fork normally in a folded relation and attached together in a convenient handle, the latter being made in separable parts so that the device may be capable of use as a knife and fork.

MOSQUITO-NET SUPPORT.—F. D. RAPPELEE, Green Bay, Wis. A purpose of the invention is to provide an economic type of net support, capable of being compactly folded, and of being quickly and conveniently unfolded and placed in position on the frame of a bed, cot, or like article of furniture, arching over the same whereby to support a net at a point above the bed or cot at its sides and ends.

Machines and Mechanical Devices.

FEEDING AND TENSION MECHANISM.—B. W. SCOTT, Detroit, Mich. The invention relates to machines for forming tubes by convolutely winding bands or strips of paper or other fibrous material coated with cement upon a mandrel, and the object of the improvement is:—to provide means for unwinding the band of tube material from the roll and drawing it through the coating mechanism at such a speed as to supply the winding mechanism as the material is required, and to stop this supply when none is required.

VENDING-MACHINE. — J. J. RONAN and J. F. BARRY, Jersey City, N. J. The invention in this case relates to vending machines, designed especially to provide coin controlled mechanism, adapted to permit a ticket to be withdrawn from the machine on depositing therein a coin of any desired denomination. While capable of being used for various purposes it is especially suitable for use in distributing railway transfer tickets.

GEARING.—J. W. LEONARD and H. E. BROWN, Washington, Pa. In the present patent the invention is designed for the provision of a gearing which is strong in construction, very effective in operation, and durable in use, and especially adapted to be employed in connection with convertible gas and steam engines for use in operating oil wells.

ATTACHMENT FOR AIR-SHIPS. — A. MATHEWS, New York, N. Y. This invention is designed to be applied to air ships having suitable propelling and steering mechanism, and has for its object to provide mechanism for the purpose of elevating the device to which it is applied. The device may be applied to air ships of any suitable construction having any desired means for propelling and steering the machine.

Prime Movers and Their Accessories.

CRANK-SHAFT.—T. J. FAY, New York, N. Y., and J. M. ELLSWORTH, Bernardsville, N. J. The invention refers to improvements in crank shafts, and more particularly to sectional or knockdown crank shafts adapted for use in connection with engines, compressors, and the like, and the object is to so construct the device that the shaft may be made of the minimum length and the ball bearing support thereof may be brought as close to the throw as possible.

Railways and Their Accessories.

TORPEDO-PLACER.—F. JAMES, Lanesboro, Pa. One purpose of the invention is to provide a device for placing a torpedo on the track in position to be exploded, and for automatically exploding the placed torpedo by the passage of the train should the engineer run by a semaphore set against him. Another is to operate the torpedo feeding mechanism and mechanism for setting the striking device, from the same lever employed to operate the signal.

CAR-DOOR.—T. A. CORSON, Portland, Ark. A door constructed in accordance with Mr. Corson's improvement cannot be fouled by freight falling against the door, since it swings entirely clear of the door opening when being opened, and moreover may rock on a vertical axis owing to its being mounted on a single wheel. By supporting the door from a single wheel or roller, only a short section of track is necessary and warping of the door will not impede the free movement thereof.

Pertaining to Vehicles.

SHOCK-ABSORBER.—W. E. SLATER, San Francisco, Cal. In its preferred arrangement the invention embodies an axle having a cavity therein, in which is movably fitted a part in connection with the body of the motor vehicle, between the walls of which cavity and said part is arranged a pneumatic cushion provided with a supply device automatically regulated by the movement of the vehicle body and its connections.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

DEVELOPMENT OF THE LOCOMOTIVE ENGINE. By Angus Sinclair. New York: Angus Sinclair Publishing Company, 1907. 6 x 8¾ inches; cloth; 661 pages, 400 illustrations. Price, $5.

This well-written book will be read with pleasure and profit, not only by American railroad men, but also by the large number of those who, while they have no practical knowledge of the locomotive, take a warm interest in this the most scientific and the most wonderful form of the steam engine. Mr. Sinclair's practical knowledge of the locomotive engine both in Great Britain and in this country has well fitted him for his task, which has extended over a period of many years. Unfortunately, the history of early locomotives is so clouded by the contradictory accounts found in contemporary literature, and the subsequent destruction of original drawings and records, that to those who have given the subject any study, it has become an axiom that to write accurate locomotive history is now practically impossible. Recognition of this fact will disarm much adverse criticism which might be leveled against this and other treatises on the subject which have been issued from time to time, and we take pleasure in saying that the present work is by far the best of its kind ever published. The sketches of the lives of American engineers who helped to develop the locomotive engine, together with some accounts of the early history of American railroads, will be read with interest and pleasure. The engravings, over 400 in number, illustrating the origin and progress of the locomotive engine, are, as a rule, well executed, but there are some notable exceptions, especially those showing British locomotives, and we would suggest that the imperfect outline of Stephenson's "Rocket" of 1829 be replaced by a correct drawing in the next edition of the book, which will, doubtless, be soon wanted. The "Rocket" was, in many respects, the most remarkable locomotive in the world, for it possessed all the essential features of the engine of to-day, and its details are worthy of study. Speaking generally, the development of the British locomotive has not, in the present work, received the attention which we think the subject merits, but in this regard Mr. Sinclair has done better than the English locomotive historians, who in their records have practically ignored the history of the American locomotive. The chapter on valves and valve motion is valuable, for there has been more study devoted to these organs of the locomotive engine than to any other, as the numerous examples here given fully demonstrate. The book is written in an entertaining style, and we can cordially recommend it.

THE OUGHT-TO-GO. London: Sampson Low, Marston & Co., Ltd., 1907. Paper; 80 pages; illustrated. Price, 1 shilling net.

A humorous brochure at the expense of automobilism, written in an essentially British vein of humor, which has been popular for the last seven years. The effort is by no means the worst of its kind, and will be appreciated by those who decry automobiling, while motorists will be able to smile at the sometimes rather cruel sarcasm of its pages.

OUTSTANDING ERRORS OF THE NAUTICAL ALMANAC. By Dodge P. Blackstone. Berlin, Wis.: George C. Hicks. Price, $1.50.

A method of correcting the calculations of the Nautical Almanac with respect to the errors due to the shifting of the poles.

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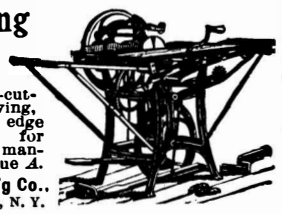

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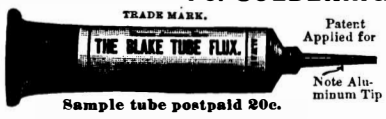

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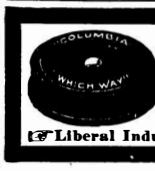

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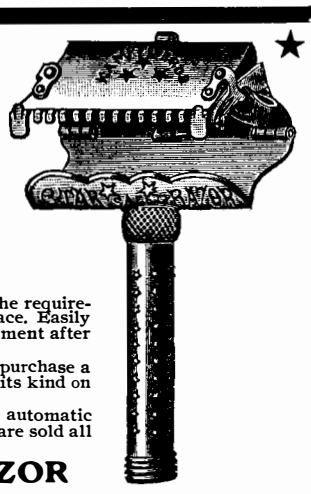

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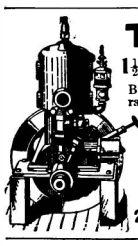

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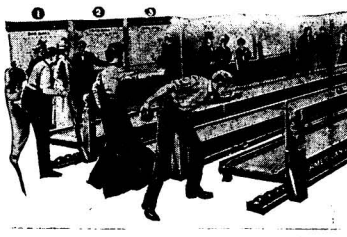

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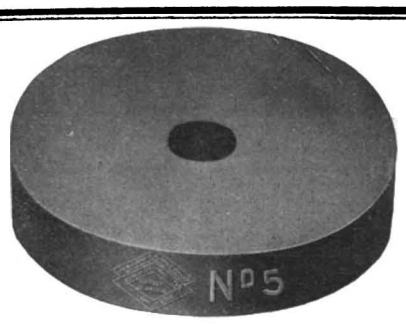

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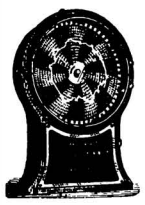

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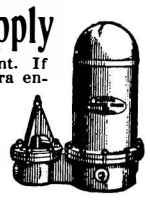

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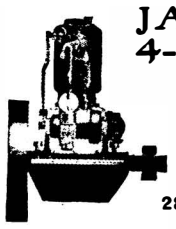

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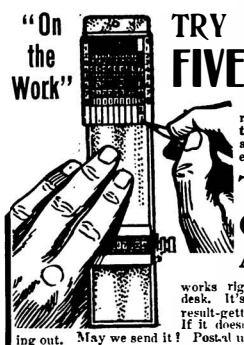

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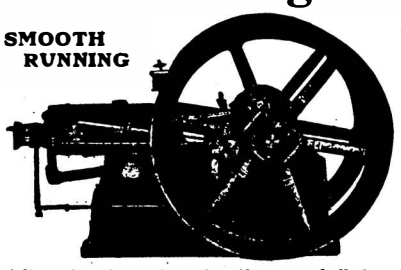

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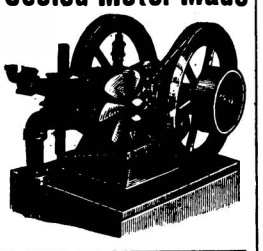

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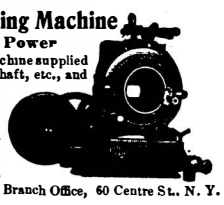

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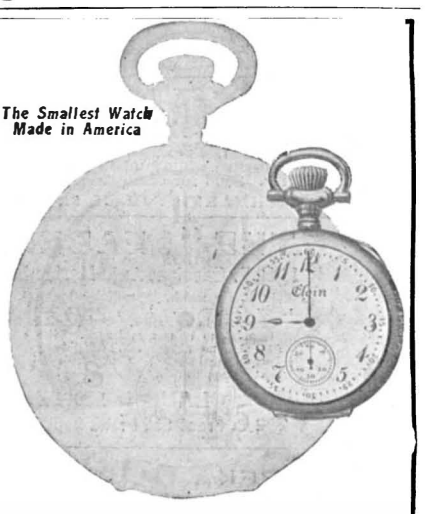

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